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Strategic Environmental Planning and Management
for the Peri-urban Interface
Research Project

ENVIRONMENTAL PROBLEMS AND OPPORTUNITIES OF THE PERI-URBAN INTERFACE AND THEIR IMPACT UPON THE POOR

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Draft for Discussion

March 1999

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The UK Department for International Development (DFID) supports policies, programmes and projects to promote international development. DFID provided funds for this study as part of that objective but the views and opinions expressed are those of the authors alone.

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1. INTRODUCTION

The objective of this document is to provide an overview of the problems and opportunities of the peri-urban interface (PUI) with regard to the broader concerns of environmental sustainability and poverty.

Urban-rural interactions are affected by and impact upon urban and rural patterns of production, consumption and mobility, and the livelihoods of an increasing number of inhabitants in developing countries. The peri-urban interface is subject to a wide range of transformations and flows that originate within and outside its domain. Most of the changes occurring in the PUI are driven by the proximity of urban areas (land conversion and new developments, market opportunities, flows of people, waste, labour, goods, capital, etc.); nevertheless the sustainability of the natural resource base and quality of life within the PUI are also affected by the linkages these areas maintain with their rural hinterland and in general with the use and appropriation of natural resources and environmental services. From an environmental perspective, peri-urban interfaces face two main challenges and the relationship between the two seems to be a key point for the design of strategic environmental planning and management (EPM) that benefits the poor and enhances the sustainable development of the peri-urban interface:

- *environmental problems and opportunities and quality of life of the poor within the PUI*: The first set of challenges are related to the environmental conditions of the PUI as the living and working environment of a large number of people in developing countries. Although heterogeneous in its social composition, the PUI constitutes the habitat of lower income communities, which are particularly vulnerable to the impacts and negative externalities of nearby rural and urban systems. This includes risks to health and life and physical hazards related to the occupation of unsuitable sites, lack of access to basic water and sanitation and poor housing conditions. At the same time, environmental changes impact upon the livelihood strategies of these communities by decreasing or increasing their access to different types of capital assets (including access to natural resources such as land, water, energy and so forth);
- *problems and opportunities for the sustainability of the natural resource base of the PUI: reconciling urban and rural development pressures.* These challenges are linked to the sustainability of the regional extraction patterns of renewable and non-renewable resources of peri-urban ecosystems, and to the minimisation of the transfer of environmental costs from rural and urban systems to the PUI. The peri-urban interface is subject to many competing interests without an adequate institutional framework to strike balances which might contribute to relieve poverty, protect the environment, maximise the productivity of human and natural resources, or draw synergy from urban and rural relationships. Therefore, the sustainability of both urban and rural areas can be dramatically affected by the dynamic and changing flows of commodities, capital, natural resources, people and pollution taking place in the peri-urban interface.

The need to consider these two sets of challenges in an interconnected way has been stressed in the principles and goals laid out in the UNCED Agenda 21 (1992) and the Habitat Agenda (UNCHS, 1996a). A distinction has been established in recent years between the ‘brown’ and ‘green’ agendas. On the one hand, there is a growing recognition of the need to pay attention to the long term environmental problems resulting from development impacts, such as rainforest depletion, global warming and biodiversity loss, generally referred to as the ‘green agenda’. On the other hand, international development agencies and local authorities have started to pay increasing attention to the so-called ‘brown’ agenda, which emphasises the need to focus on specific problems associated with the deterioration of local environmental conditions, such as waste water and solid waste management, air pollution and similar immediate problems affecting the health and quality of life of an increasing number of inhabitants in the urban and peri-urban systems of the developing world. However, it is still common to consider each agenda separately, that is, focusing attention either on local environmental problems which have immediate and evident impacts on people’s health and quality of life or looking at sustainability issues exclusively from the perspective of the natural resource base. As argued by Atkinson and Allen (1998), “[i]t is thus necessary to emphasise that even in the context of the

urgent need to improve management of such immediate problems as urban (and peri-urban) sanitation, drainage, water supply, solid waste disposal and air pollution, it is nevertheless necessary to forge solutions which *also* address the problem of sustainability" (p. 11).

Most of the analysis in this document is based on the findings of the three case studies selected for the first phase of the project: the city regions of Kumasi (Ghana), Hubli-Dharwad (India) and Manizales-Villamaría (Colombia). Information on the first two cases is based on a series of studies and on-going projects commissioned by the Natural Resources Systems Programme (DFID) and the findings from several visits conducted by the DPU team during the first phase of the project. Information about the case of Manizales-Villamaría has been produced by the PUI team in collaboration with the local partner institution for the project in Colombia, the Institute for Environmental Studies (Instituto de Estudios Ambientales - IDEA). Although the discussion is mainly illustrated with reference to these three case studies, the document intends to provide an overview of the environmental problems and opportunities of the PUI relevant to other cases in the context of the developing world. This is laid out in five sections.

The first section is concerned with providing a working definition for the analysis of the environmental conditions of the PUI. The section starts by examining the various interpretations of the peri-urban interface, in a situation where there is still little consensus on its conceptualisation. It goes on to discuss the assumptions that informed the working definition adopted in this document, with the aim of providing some key concepts for understanding the role and significance of the peri-urban interface in environmental terms.

The second section provides an introduction to some of the factors that need to be looked at for a better understanding of the wider pressures giving rise to environmental change in the PUI. These include the consideration of the speed and nature of development and urbanisation trends affecting the PUI; the analysis of rural-urban interactions and flows of people, goods, capital, information, natural resources and wastes; the implications of the expansion of the ecological footprint of urban areas upon the carrying capacity of the PUI and the challenges posed by the complex structure of different and overlapping institutions with a remit in managing and planning the PUI.

The third section examines the empirical aspects of the peri-urban environment, providing a characterisation of the problems and opportunities that emerge from the use of natural resources and environmental services of the peri-urban interface. It starts by considering the impact of changes on land use and then goes on to discuss three essential conditions for the environmental sustainability of the PUI: the use of renewable resources and non-renewable resources and the impact of the generation of wastes and pollution in relation to the absorptive capacity 'sink' of peri-urban environments. The fact that particular environmental problems and opportunities arise out of specific conditions is stressed, which are not exclusively physical but are interrelated with social, cultural, economic and institutional issues and need to be managed with reference to each specific context.

Section four is concerned with providing an understanding of the impacts of the environmental conditions examined in the previous section upon the livelihood strategies and quality of life of the poor. This section starts by examining the relationship between environmental conditions, poverty and access to capital assets in the PUI. Acknowledging that more research is needed in this area, the discussion draws on the literature review produced by Rakodi (1998) which suggests a series of valuable hypotheses to guide further research. The discussion goes on to stress the need to disaggregate the groups that are most affected by the environmental problems identified, paying particular attention to the likely impacts on the health of the poor and to the gender dimension of the distribution of impacts. Finally, attention is given to the disadvantaged position of low income groups within the struggle for land use and appropriation *vis à vis* other social groups, with regard to the conditions constraining their access to political decision-making.

The fifth section draws the main conclusions from the previous analysis and proposes a series of considerations for the environmental planning and management of the peri-urban interface.

1.1What is the Peri-urban Interface (PUI)?

As discussed in the PUI project Output 1 (Adell, 1999), the analysis of the processes of development and urbanisation in developing countries has been traditionally structured around dichotomies such as urban-rural, traditional-modern, formal-informal, etc. Within this framework, the PUI constitutes an 'uneasy' phenomenon usually characterised either by the loss of 'rural' values (loss of fertile soil, natural landscape, etc.) or the deficit of "urban" attributes (low density, lack of accessibility, lack of services and infrastructure, etc.). Population and built-up density, infrastructural characteristics, administrative boundaries and predominant economic activities are the main variables conventionally used to distinguish rural from urban. The arguments presented in Tacoli's review (1998) show that these criteria are debatable and vary in different contexts, while other definitions based on these criteria usually fail to capture the changing nature of the PUI.

The distinction between urban and rural is insufficient to characterise the communities and the landscape of peri-urban areas as 'border' territories. The urban-rural dichotomy is a reflection of the arbitrary definitions applied by professionals and institutions, who tend to move behind the physical and socio-economic processes currently reshaping the territory. Although there is no consensus on the conceptual definition of the PUI, there is an increasing recognition among development professionals and institutions of the fact that rural and urban features tend to increasingly coexist within cities and beyond their limits, and related issues tend to emerge as priorities for action in a significant number of projects.

From the outset, it is relevant to mention that most literature reviews focused on the PUI highlight the lack of information on 'peri-urban areas' and use urban and rural information to build hypotheses for this 'transitional' zone (Birley and Lock, 1998; Birmingham *et al.* 1998; Rakodi, 1998; and Nottingham and Liverpool, Universities of, 1999):

> The effort to identify research which specifically focuses on poverty in peri-urban areas drew a near-blank. (…) Most of the analysis which follows will, therefore, consider rural poverty and urban poverty (Rakodi, 1998: 3).
>
> Much of the review… overviews related theories and concepts, and extrapolates the processes in operation in peri-urban areas from literature on related spatial areas, particularly the city itself (Nottingham and Liverpool, 1999: 3). There are no models in the literature which describe a separate set of natural processes for peri-urban areas (op. cit., p. 74).
>
> A large number of studies have described urban health issues but little health research has focused on peri-urban natural resource production. In our review, health hazards are identified either from specific peri-urban research or, more often, by reference to urban and rural differences (Birley and Lock, 1998: 90).

As is apparent, inferences about environmental problems and opportunities in the PUI should be viewed as tentative and still operating at the level of hypothesis. However, some general approaches to the conceptualisation of the 'peri-urban interface' can be identified:

1.1.1 The PUI as the Periphery of the City

This is one of the most common definitions applied in the studies reviewed and in concrete management interventions[1]. It implies that the PUI comprises the areas surrounding the city in the process of being urbanised. Proximity to urban areas and lack of urban attributes, such as urban infrastructure, are the underlying criteria to define the PUI. Changes in the PUI are related to the impacts of urban development (social and physical) on the near rural areas (implicitly disregarding the opposite direction of influence and of policy orientation). The growth of urban

[1] See Output 2, Budds and Minaya, 1999.

areas, for instance in the physical sense, is taken as natural:

> …areas immediately surrounding cities (…) where farmland is being developed for urban uses and the rural economy is significantly affected by its urban links (Birley and Lock, op. cit., p. 37).
>
> The expansion of peri-urban areas can be considered as part of the wider urbanisation process. Indeed, the development of a peri-urban area is an inevitable consequence of urbanisation. As cities in developing countries continue to grow, the peri-urban area moves outward in waves (Nottingham and Liverpool, Universities of, 1999: 2).

1.1.2 The PUI as a Socio-economic System

Other approaches to the conceptualisation of the PUI move away from its physical features and focus on its socio-economic characteristics. 'Peri-urban' is understood as a social category, regardless of its spatial location, but often related to the fringe of the city. In other words, peri-urban communities are those which have a dual urban-rural orientation in social and economic terms.

> Peri-urban areas are areas of rapid social change, in which rural settlements adjust economically and socially to urban influences, both opportunities and threats, and in which existing populations are added to by in-migrants from either the inner city or other parts of the country (Rakodi, op. cit., p. 45).
>
> The peri-urban zone can be broadly characterised as a mosaic of different land uses inhabited by communities of different economic status, in a state of rapid change with a lack of infra-structure and a deteriorating environment. It is a transition zone that is entirely rural at one end and urban at the other… (Birley and Lock, 1998: 89).

This approach highlights an important aspect of the PUI, that is the recognition of the way in which rural and urban household strategies overlap in the process of development. However, peri-urban communities are usually assumed as socially and economically disadvantaged, often engaged in informal and agricultural activities. A comparative study by Browder et al. (1995) challenges this view, highlighting that a vast majority of residents in the metropolitan fringes of Bangkok, Jakarta and Santiago were found to be lower and middle income dwellers relocated from the city centre and most of them integrated to the urban economy. Other studies confirm the dual rural-urban orientation of peri-urban dwellers, not as a common feature to all residents but particularly related to lower income groups. In his analysis of the rural linkages of urban households in Durban, South Africa, Smit (1998) shows how 'circular migration' among low income households "can involve multiple rural, or semi-urban bases and a number of urban work sites, and include oscillatory movement between urban and rural homes and, in some cases, constant on-migration" (p. 79).

1.1.3 The PUI as the Interaction of Rural-urban Flows

A third approach, present in all the literature reviews analysed, attempts to explain the nature of the PUI by looking at the dynamics of rural-urban links and flows at the regional level. Peri-urban interfaces are assumed to be areas where urban-rural linkages, changes and conflict (economic, social, and environmental) are most intense:

> [m]any of the rural-urban flows of people, goods and wastes are **most intense** and **varied** between the built-up areas of towns and cities and the peri-urban areas that surround them (Tacoli, 1998:159).
>
> ... conceptualising the peri-urban interface production system as a series of interconnected flows and changes over time helps to ensure that the system is represented as a dynamic one, *since the pace of change in the interface is rapid*, and the flows within and between production systems are significant

(Rakodi, 1998: 9) (italics added).

These definitions focus on 'processes' rather than 'states' and seem to be more appropriate to deal with the shifting nature of the PUI, considering the broad and multidirectional processes affecting changes there. For instance, changes in land use might not necessarily be driven by the expansion of urban areas, but by the processes of de-agrarianisation of rural areas and of the promotion of industrial decentralisation at the regional and national level.

Rural-urban linkages and flows relate to social, economic and political factors rather than place. In other words, they involve a set of wider phenomena, which explain the structural changes between the functions of urban and rural areas that might go well beyond the PUI as a recognisable and specific biophysical system. Therefore, the analysis of rural-urban linkages at the regional level provides a necessary framework to understanding the nature and speed of environmental and social change in the PUI, but is still too broad to provide a working definition for identifying the 'place' and specific characteristics of the PUI as a spatial system. Findings from the NRI's Hubli-Dharwad project emphasise that "the dynamism of the peri-urban zone in terms of economic, cultural and environmental change illustrates the importance of the flows of people, commodities, energy and wastes…" However, whilst this suggests that the traditional spatial conceptualisation of the peri-urban area may be inadequate, nevertheless the rapidly changing human activities take place on a terrestrial surface. Land, therefore, provides both a real and a conceptual link between movements and their spatial context" (Nottingham and Liverpool, Universities of, 1999: 8).

1.2The PUI as a Particular Ecological and Socio-economic System

Following the above considerations, it will be argued that a working definition of the PUI needs to be based on the singular features that characterise it as a particular system in biophysical and socio-economic terms, taking into account the dynamics of rural-urban flows into and across the system. In many senses, the particular features of the PUI are based on the mix and coexistence of urban and rural features. The PUI is a highly dynamic and complex system of land use, which possesses both the characteristics of an **ecological and socio-economic interface**. As highlighted by Morello (1995), the PUI presents particular attributes constituting a system affected by similar processes to those which take place in the expansion of 'agrarian frontiers', such as:

- increasing pressure over the biophysical support reflected, for example, in the replacement of natural or semi-natural soil and vegetation with artificial impermeable surfaces, and the routing of rainwater along drains and sewers altering natural hydrological networks;
- urban expansion resulting in new economic opportunities, such as land speculation, but often at the expense of high environmental costs, due to the lessening or cancellation of essential ecological functions such as the recycling of nutrients, replenishment of aquifers, absorption of pollutants, etc.;
- emergence of informal activities such as the use of raw organic wastes to increase vegetable production, mining and extractive activities for the production of building materials, clandestine abattoirs, deposition of toxic wastes and open-site dumping, etc.;
- new conflicts emerging among numerous actors who exert pressure over the access of others to the use and appropriation of environmental resources;
- land use changes in the PUI are often driven by decisions taken outside the system, such as the promotion of free-standing industrial estates and the construction of motorways or dams.
- land values and ownership are subject to rapid changes which often result in more landless people and clashes between indigenous land management systems and the market, institutional and legal confusion over land management;
- traditional natural management systems are disrupted and extractive activities are intensified, such as deforestation, mining, sand extraction and quarries;
- traditional productive activities are wiped out, affecting the livelihoods of the poorest. For example, open-field horticulture tends to disappear due to the decrease of soil quality due to sediments produced by cement plants and power stations;
- household livelihood strategies of low-income groups tend to be characterised by a mix of

natural and non-natural resource based activities and by relationships of mutual exchange and support between rural and urban communities.

Most of the problems outlined above can be seen as opportunities if the peculiarities of the PUI are considered in the light of a strategic and specific management approach. For example, the absorptive capacity of peri-urban systems and the capacity for natural resource regeneration are higher than the ecological services that urban systems can provide. In the same way, the PUI often offers more diverse economic and social interaction opportunities than rural systems, and these can have a positive impact on the livelihood and quality of life of the poorest, if equal access to those opportunities is regarded as an explicit management and policy objective.

The working definition adopted in this document is not based on prescriptive conditions (distance to urban areas, density or infrastructure) but on the specific characteristics of the PUI as a distinct ecological and socio-economic system under uncertain institutional arrangements. This definition provides a basis for understanding not only the emergence of problems, but also opportunities for the development and sustainability of the continuous rural and urban systems and the communities living and working within the PUI.

As an ecological interface, the PUI is characterised by inadequate urban services and infrastructure, such as water supply and sanitation, electricity, drainage, paved roads and refuse collection, and also by the lessening of 'ecological services' provided by rural and natural systems, such as the capacity of absorbing carbon dioxide, fixing solar energy into chemical energy transforming it into food, decomposing of organic matter, recycling nutrients, controlling the balance between species of flora and fauna to avoid plagues, regulating water flows, moderating climatic changes at the micro level, absorbing, retaining and distributing rainwater, etc. The replenishment of aquifers and the capacity to absorb rainwater and to metabolise the concentration of substances of difficult and slow decomposition are some of the essential ecological processes performed by the PUI.

From a socio-economic viewpoint, the PUI also presents several peculiarities. The continuous but uneven process of urbanisation taking place in these areas is generally accompanied (or in many cases produced) by land speculation, shifting economic activities of higher productivity and the emergence of informal and often illegal activities such as clandestine abattoirs, intensive use of agro-chemicals and fertilisers for horticulture production (often accompanied by exploitative labour conditions of illegal immigrants), mining activities for the supply of building materials, etc. As a result, the social composition of peri-urban systems is highly heterogeneous and subject to changes over time. Small farmers, informal settlers, industrial entrepreneurs and urban middle class commuters may all coexist in the same territory but with different and often competing interests, practices and perceptions.

A third distinctive characteristic of the PUI is the lack of institutions capable of addressing the links between urban and rural activities. This is reinforced by the convergence of sectoral and overlapping institutions with different remits. Institutions of local government tend to be either urban or rural in their focus, metropolitan governments - few in any case - rarely include rural jurisdictions, special purpose authorities bridging urban and rural areas are not created, and district and regional governments do not adequately link urban and rural concerns. Poor management of peri-urban areas obstructs both rural and urban development, an issue that will be discussed in more detail in section 2.

From an environmental perspective, the term **peri-urban interface** provides a **systemic** view which attempts to reinstitute the specificity and complexity of the processes between society and the biophysical support in these new territories, reinterpreting them as peri-urban systems. The PUI is characterised by a heterogeneous mosaic of 'natural', 'productive' or 'agro-ecosystems' and 'urban' ecosystems, affected by material and energy flows demanded by urban and rural systems. In ecological terms, all ecosystems can be classified energetically by applying the ratio between production (P) (energy absorbed or transformed) and consumption (C) (loss of energy):

- in natural ecosystems the ratio P/C is equal to one, typically these are ecosystems subject to low levels of disturbance, such as natural forests;

- agro-ecosystems or productive systems are characterised by a ratio P/C which tends to be higher than one, such as crop areas or tree plantations where the energy resulting from the photosynthesis of the ecosystem is exported and consumed beyond its limits (for instance, food, meat, cereals, etc.);
- urban ecosystems are by definition 'consumer ecosystems' where P/C tends to be lower than one. In other words, their production tends to be minimal due to the fact that their biomass is insignificant and the value of consumption tends to be over-dimensioned from the energy imported from natural and agro-productive ecosystems.

The complexity and ecology of the biophysical support in question condition the extent to which different human pressures are likely to result in environmental problems or opportunities. For instance, in desert regions the availability of water is much lower than in tropical regions: accordingly, the admissible ecological limits for the exploitation of water without inflicting damage to the ecosystems' health should be expected to be lower.

However, the peri-urban environment is not only defined by these ecological features but by the diverse processes of interaction between three sub-systems: socio-economic (individuals and their different levels of organisation and multiple forms of interrelation), territorial (physical natural components transformed at different degrees) and artificial (built-up components such as infrastructure, roads and housing). The processes of interaction between these three subsystems are affected and conditioned by different factors, which might be related or external to the peri-urban environment, notably the influence of nearby urban systems for which the PUI constitutes a metabolic support system. Each of these subsystems conditions each other and is conditioned at the same time by the other two. Although incipient, an environmental conceptualisation of the peri-urban interface has several implications for its analysis and for devising policy interventions:

Firstly, the environmental perspective opens a new understanding and evaluation of these processes, calling upon the articulation of social, economic and biophysical aspects. In this way, the processes of differential valuation and private appropriation taking place under highly heterogeneous conditions in the PUI acquire new perspectives. For instance, the processes of private appropriation of land, either through real estate speculation or through the direct marginalisation of certain groups within society created by disparities in the distribution of public expenditure in the territory and spatial segregation, reinforce unequal conditions of environmental quality within society. In this way, areas subjected to environmental hazards often become the habitat of lower income groups, whilst those areas of high environmental quality constitute the epicentre of speculative mechanisms (through the process of land conversion from agro-productive and natural uses to urban), subtracting or 'freezing' the capacity of these areas for the productive accumulation of previous dwellers or cancelling valuable ecological functions performed by natural systems.

Secondly, the consideration of the carrying capacity of the territory (landscape quality, soil productivity, vulnerability to floods, availability of drinking water, etc.) poses more appropriate criteria for the assessment of the environmental aptitude of the PUI than the conventional zoning criteria based on density, morphology, distance and urban and rural uses of the territory. Conventional urban planning has favoured a centrifugal view from the urban to the 'non-urban space', inadequate to address the characteristics and functioning of the 'patchwork' structure of the peri-urban interface, in terms of attributes, uses, functions, values and strategies of occupation of the territory and appropriation and transformation of its natural resource base.

Finally, an environmental perspective contributes to the formulation of a genetic approach in the analysis of how peri-urban systems are constituted and of how they transform, thus also in the long term articulating the synergies and trade-offs established between environmental sustainability, economic productivity and social equity. This view also provides new concepts for understanding the environmental impact of different pressures and processes of change operating in the transformation of peri-urban systems. A new approximation to the comprehension of the peri-urban interface cannot simply be based on the extrapolation of the features and processes affecting rural and urban areas but on the construction of a methodological approach centred on the specific aspects of the PUI (in environmental, social,

economic and institutional terms) and its differential processes of occupation and transformation with regard to the natural resource base, the activities taking place and the ways in which heterogeneous social groups live and work in the PUI.

2. PRESSURES GIVING RISE TO ENVIRONMENTAL CHANGE IN THE PUI

This section looks at some of the factors which help to identify the broader pressures giving rise to different processes of environmental change in the PUI. Whilst some of them are related to physical support, most of them are related to social, economic and institutional conditions.

2.1 Speed and Nature of Change

The processes taking place in the PUI are either seen as a result of an inexorable drive in the expansion of urban economic activities over traditional rural economies or as a negative process that should be limited and controlled, thus preserving a clear distinction between cities and countryside. These views have too often involved different preconceptions that neither consider in any depth the **advantages** nor the **disadvantages** of these processes and changes. It is therefore necessary to consider in some detail the nature and speed of the pressures affecting the PUI and their correlation with the processes of urbanisation and development in each context.

Peri-urban areas are increasingly shaped by the process of territorial specialisation encouraged by globalisation and therefore subject to accelerated processes of social, economic, political and environmental change, which redefine their conditions of competitiveness, equity, governance and sustainability. It is important to notice from the outset that the process of urbanisation in the countries of the South has not always been accompanied by economic development. Rapid urbanisation in many countries in Asia, Africa and Latin America has been historically characterised by a weak relationship between the development of urban systems, their hinterlands and their insertion in the modernisation process. Even in those countries experiencing high levels of associated urbanisation and economic growth, the process has often been accompanied by uneven distribution within urban regions and at the expense of increasing environmental costs, which compromise the long term sustainability of those regions. When analysing peri-urban systems in terms of development trends and size, there is no common pattern, with some countries experiencing more rapid growth in metropolitan areas, some around intermediate cities and others in rural towns.

Different processes characterise the emergence and transformation of peri-urban areas, demanding an original and context-specific approach. For instance, in Latin America, during the 1950s, the migration flow from the countryside to urban areas was connected with the failure of the regional attempt to develop an intensive agriculture model and a network of agro-production service centres. Since the 1960s, the development process of many countries in the region has been characterised by a great imbalance between the immigration flow into cities and their carrying capacity both in terms of natural resources and physical infrastructure. Since then, the expansion of urban areas over natural and agro-productive systems has been a characteristic process which has resulted in the emergence of new landscapes with mixed urban and rural features. Nowadays, the percentage of urban population varies between 40% and 80% in different countries, linked with migration flows not only from the countryside to urban centres but between different cities and metropolitan areas. The endemic weakness of the regional development of urban and peri-urban systems is currently connected with faster urbanisation than the growth rate of formal secondary and tertiary employment. In this context, urban and peri-urban systems fail to provide the new dwellers not only with physical accommodation, but also with a full integration into the development process (Allen, 1999).

In contrast with Latin America, urbanisation is a relatively new phenomenon in Africa. In the

1950s, most countries in the region had an urban population below 10%, reaching an average between 20% and 50% in the 1990s. However, Africa currently experiences the highest rate of urbanisation among the developing regions[2], but in a situation of economic stagnation and decline. Asia is the most varied of the regions, whilst many countries remain predominantly rural, in others, such as Thailand and the Philippines, urban functions are spreading into wide sub-regions through the decentralisation of modern industries. As argued by Atkinson and Allen (1998), "[s]uch urban regions are structurally extremely complex, comprising at least three kinds of city in one: a 'modern' city of international middle classes with a 'western' lifestyle, an indigenous urban middle class and a 'rurban' class of poor, some with continuing rural links though increasing numbers are now fully urbanised, living in informal settlements lacking basic urban services and suffering multiple hazards" (Allen and Atkinson, 1998: 22).

2.2Urban – Rural Flows and Interactions

Several authors have suggested that the processes of social and environmental change taking place in the PUI need to be considered in the light of complex rural–urban interactions, which include the consideration of flows of people, goods, income, capital, natural resources and wastes (Tacoli, 1998). These flows can be either rural or urban oriented and in fact it is usually difficult to identify their source, as processes driven by factors and decisions at different levels may be cumulative and mutually reinforcing, converging into a single process. For example, migration to the PUI might be promoted by "high population densities in rural areas, shortage of cultivable land, declining soil fertility, increasing commercialisation of agriculture and agricultural land markets, inequitable land ownership patterns and exploitative landlord-tenants relations as well as government support for cash crops" (Hardoy et al, 1992: 113). This might be seen as a rural problem, but decreasing opportunities in rural areas can be largely the result of commercialisation of crop production driven by city-based demand. In most cases, environmental and social changes in the PUI are not simply the result of either the movement of rural households into ecologically vulnerable areas or a unidirectional spread of urbanisation onto agricultural land. In his study of land use changes in the metropolis of Jakarta, Douglass (1989) shows how environmental problems of the PUI such as loss and degradation of prime agricultural land, water pollution from both urban and agricultural uses and severe threats to areas of natural forest, coastline and marine ecosystems were in fact the outcome of "negatively reinforcing impacts of *both rapid urbanisation* and *the rapid expansion of rural land use in coastal, upland and forest areas* in the region reaching beyond the Jakarta agglomeration, and along the Jakarta-Bandung corridor*"* (cited in Hardoy et al., 1992: 111).

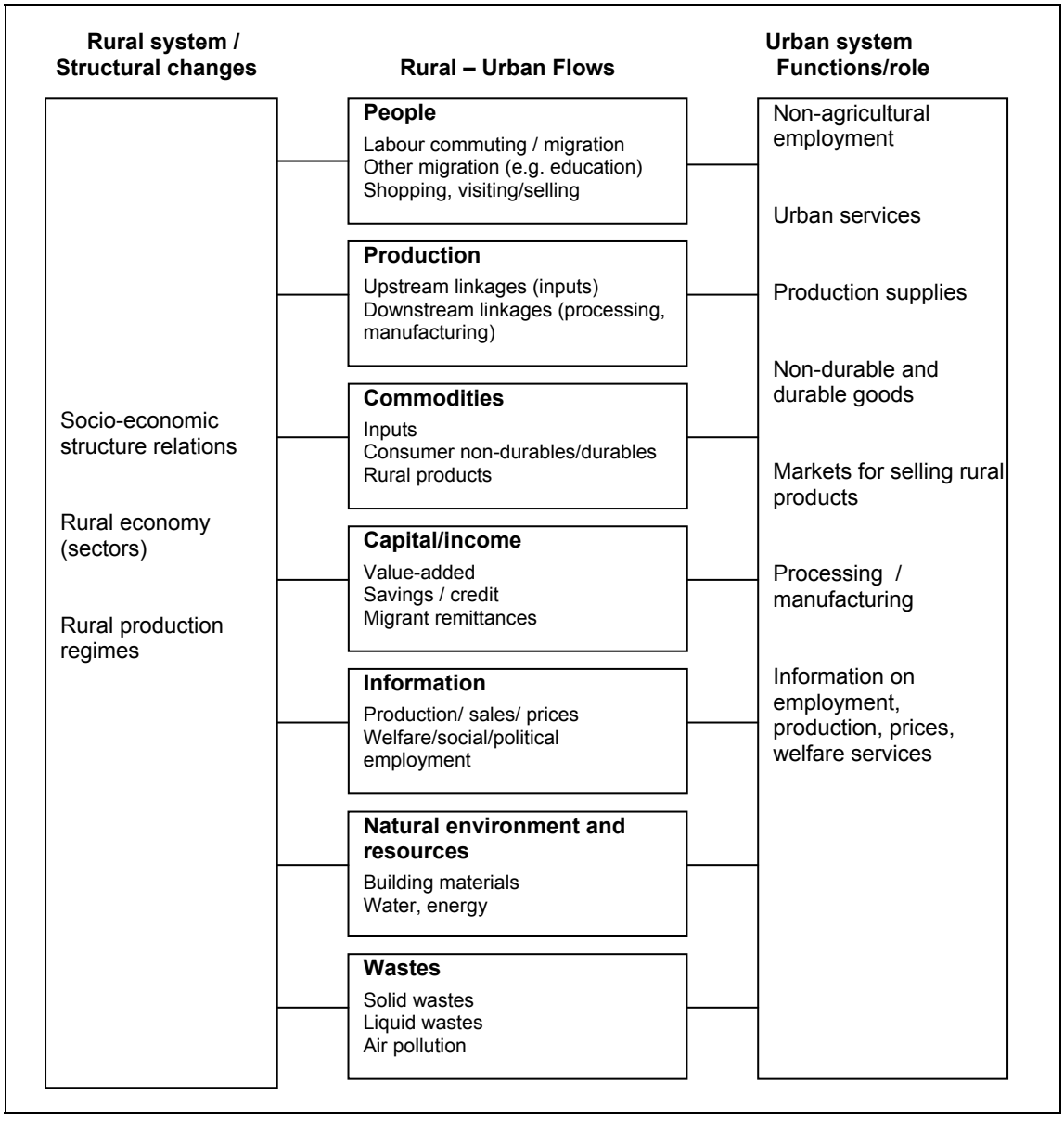
In summary, the analysis of flows shaping and reshaping the use of environmental resources and ecological services in the PUI might be driven by local conditions (for instance the competition between urban development and agriculture for land or increasing pressure of extractive activities as a response to the city demand for building materials), by regional and national conditions (for example, the promotion of industrialisation) or by international conditions, such as falling prices of export crops increasing the migration of impoverished farmers from rural areas to the PUI in search of alternative livelihood opportunities. As argued by Douglass (1989), "[h]istorical factors related to the development of each city and region, the presence of government, and the nature of linkages with the national and international economies add to the diversity" (p. 16). "... [M]any studies show, for example, that local towns may be bypassed as centres for agro-processing, markets and other urban functions as transportation linkages to more distant, larger towns are improved" (p. 19).

Michael Douglass (1998) proposes an analytical framework for understanding how rural-urban linkages or flows can be mutually reinforcing or truncated leading to different trajectories and reciprocal or opposite relationships between urban and rural development. Figure 1 presents a slightly modified version of this framework, which suggests that rural and urban systems (or structures in his framework) are linked through a set of flows (people, production, commodities, capital and information). Particularly relevant to the analysis of the environmental changes in the

[2] The rates of urbanisation currently range from an average of 4.4% per year in Africa, 3.3% in Asia and 2.5% in South America (Atkinson and Allen, 1998).

PUI is the consideration of the flows of natural resources and wastes. For the purpose of this study, it is important to notice that the PUI is the system *par excellence* where many of the bottlenecks in urban-rural flows take place, leading to problems and opportunities not only for peri-urban communities but also for the sustainable development of adjacent rural and urban systems.

Figure 1: Reciprocal Rural – Urban Interactions



Source: Based on Douglass, 1998, p. 31.

2.3Carrying Capacity and Ecological Footprint

Cities impose high environmental impacts on wider regions beyond their physical and jurisdictional limits, both by drawing from them the resources necessary to support their inhabitants and economic activities and by transferring pollution and wastes. The wealthier the city the larger the area from which these resources are drawn or, in other words, the larger its 'ecological footprint' becomes (Rees, 1992).

As pointed out by Harvey (1996), "[*each bundle of innovations [transportation, communications,*

etc.] *has allowed a radical shift in the way that space is organised and therefore opened up radically new possibilities for the urban process. Breaking with the dependency upon relatively confined bioregions opened up totally new vistas of possibilities for urban growth*" (1996: 412). "…[*T*]*he development of an interrelated and ultimately global network of cities drawing upon a variety of hinterlands permits an aggregate urban growth process radically greater than that achievable for each in isolation*" (op. cit.: 413) (italics added).

However, the breaking down of supportive reciprocal relations between cities and their hinterlands or, in other words, the dissolution of urban bioregions, tends to aggravate unsustainable patterns of natural resources use and the transference of environmental problems to distant regions. The concept of the 'urban ecological footprint' is useful to understand how the relationship between cities and their hinterlands changes over time and the environmental costs associated with these changes. Increasingly through trade and natural flows of ecological goods and services, cities tend to draw on the material resources and ecological productivity of vast and scattered hinterlands. This means that not all environmental changes in the peri-urban interface are necessarily shaped by city-based demands. As cities expand their ecological footprint, appropriating the carrying capacity from distant elsewheres, the picture seems to get more complicated. However, as Ian Douglass (1983) notes, bulky and low value materials required for the physical structure of the urban fabric, such as building materials, are usually drawn from close by, which results in the proliferation of extractive activities of high environmental impact in the PUI, such as claypits, quarries, brick works, sand and gravel pits. The same is true for the deposition of urban wastes. It is too expensive to transport wastes long distances and therefore the peri-urban system adjacent to a city tends to be the prime location for such wastes.

The expansion of the ecological footprint of each city has important implications for the peri-urban interface, both in terms of increasing pressures over its carrying capacity and in terms of missing opportunities for its production, for instance, when food is imported from distant regions rather than supplied from the city's hinterland. The quest for reciprocal and environmentally sustainable relations between urban, peri-urban and rural systems demands a reappraisal of the concept of 'urban bioregion'[3], which calls for a close consideration of the nature of these relations as a paradigm for sustainable EPM.

2.4Institutional Landscape

The problem of institutional fragmentation is particularly relevant for understanding the emergence of environmental problems and institutional constraints conditioning environmental planning and management in the PUI. Peri-urban areas often share the territory of more than one administrative unit, with weak links and limited municipal power in sectors such as transport, water, energy, solid and liquid waste management and land use planning and this results in uncertainty as to which institution administers which specific area or activity. In social and economic terms these areas are strongly connected through complementary industrial and service functions between neighbouring districts and an increasing number of commuters. These links are even closer at the time of managing environmental resources and controlling contamination and degradation processes. No single district is able to apply an isolated approach to supplying the qualitative and quantitative water and energy flows required by its population and activities or to manage the wastes and pollution generated within its jurisdictional limits. The emergence of the so-called 'regional metropolitan areas'[4] asserts the need to rethink the validity of existing jurisdictional and institutional arrangements. Regional metropolitan areas are characterised by a highly integrated and dispersed settlement pattern, within which several towns and cities with relatively low concentrations of population perform complementary functions in the provision of services and infrastructure and the development of

[3] For a detailed explanation of this concept see Atkinson 1992, 1993.

[4] The case of the Upper Valley Metropolitan Region in the North of Patagonia, Argentina, clearly illustrates a settlement pattern where metropolitan functions for a vast region are performed by a group of three intermediate sized cities and several small towns (Vapnarsky and Pantelides, 1987).

economic activities.

The environmental management of the PUI demands a conceptual and methodological approach that moves away from the physical definition of urban and rural areas (understood as clearly limited geographic and administrative entities) to a broader understanding of the articulation of complex patterns of settlement and resource use, where the flow of natural resources, capital, goods, services and people do not fit in with jurisdictional boundaries.

3. ENVIRONMENTAL PROBLEMS AND OPPORTUNITIES IN THE PUI

This section explores the processes of environmental change commonly affecting the PUI and the problems and opportunities which arise from them. Problems and opportunities are identified with regard to two main concerns: the sustainable management of environmental resources and services at the regional level and the quality of life of the most disadvantaged groups living and working in the PUI.

Some authors suggest that processes of environmental change in the peri-urban interface do not differ from those in geographically similar rural or urban environments (Nottingham and Liverpool, Universities of, 1999). However, it is argued in this section that although the effects of those processes might appear similar, the processes of environmental change and their implications for the sustainable management of the resource base and quality of life of the poorest in the PUI are different in so far as peri-urban systems constitute particular ecological and socio-economic systems.

On the one hand, the peri-urban interface is constituted by a peculiar mosaic of ecosystems (from ecosystems of high to low ecological productivity). On the other hand, environmental transformations of the peri-urban environment are, to a large extent, driven by the pressures exerted by external, although often nearby, systems[5]. Among the pressures exerted to peri-urban systems are inadequate development processes, unequal distribution of services and investments, the relationship between households' assets and consumption, the conditions of the natural environment, the inadequate localisation and functioning of economic activities, the lack of provision of adequate services, the scale and nature of demographic growth, the absence of institutional management capacities, etc. These pressures often result in:

- environmental hazards threatening the quality of life, such as the depletion and degradation of environmental resources, loss of agricultural land, etc.;
- ill-health and malnutrition for the poorest and other conditions derived from precarious living environments;
- other environmental hazards resulting from the disposal of wastes beyond the local and regional absorptive capacities.

The analysis in this section is structured around four main processes of environmental change: land use changes, use of renewable resources (water resources, soils and biomass), use of non-renewable resources (fossil fuels, minerals and biodiversity) and waste generation and pollution (use of the absorptive or sink capacity for wastes).

3.1 Land Use Changes

A characteristic of the PUI is that land is under intense pressure due to several processes of land use conversion. Changes in land use from non-urban (rural and/or natural) to urban

[5] As argued by Satterthwaite (1996), improvements in the quality of life of urban systems are often made at the expense of extra-urban or peri-urban areas, which are likely to bear a disproportionate share of environmental burdens.

activities affect in turn the physical form of the environment as well as the economic and social features of the PUI. These changes are not only a result of urban sprawl but also of the loss of farmland in rural areas due to the process of de-agrarianisation, which is an important process in explaining the causes and dynamics of poverty and environmental degradation. It is important to note that the processes of land conversion do not exclusively affect farmland but also natural areas. The main processes of land use change to be considered include:

- in-migration of the rural poor who settle in the PUI[6];
- loss of agricultural land due to the physical expansion of the city (usually along major transport routes) with farm land engulfed in the urban fabric;
- the urban poor moving towards the outskirts where rents and land prices are lower;
- the better-off building new houses in less congested areas;
- land speculation (change in land uses but land remains used for rural purposes);
- industrial location policies.

Industrialisation in the PUI follows two patterns. On the one hand there is a proliferation of small scale industries associated with construction activities, on the other, large scale industrial estates are leading the process of land conversion in many of the cases examined, particularly (but not exclusively) in the outskirts of large cities. Whilst the first process might be characterised as 'spontaneous', the increasing development of free-standing industrial estates in the PUI is often associated with national and regional policies promoting the decentralisation of industrial development. In the cases of both Manizales and Hubli-Dharwad, new large-scale industrial activities in the PUI are not emerging in response to the demand created by city growth, but rather their location is the effect of regional strategies aiming at decentralising industrial development from the main urban centres due to the pollution and nuisance caused by these activities. This process has implications for poverty and access to healthy, safe and productive environments.

Land conversion from agricultural and natural to residential uses is another typical process taking place in the PUI. This process is connected with both the out-migration of city residents into peri-urban areas seeking more attractive environments, more space and cheaper building land, but also with the in-migration of rural dwellers for whom the PUI offers cheaper land and housing, a more familiar environment and more diversified livelihood sources (rural and urban). Box 1 illustrates the relationship between the process of land conversion, environmental degradation and poverty in the city region of Kumasi, Ghana.

[6] Especially in contexts where migration still contributes substantially to the growth of urban population (Africa), the need for new land for the expansion of the city is felt increasingly on the areas surrounding the city. Although specific data and research in this respect is still lacking for other cities, the case of Kumasi - with a population of about 700,000 and a growth rate of 2.5% - shows that the effects of the physical expansion of the city are being felt as far as 60 km, away from the centre of the city. In cases where migration does not play a similarly important role in explaining urban growth (Latin American cities), the geographical extent of land conversion can be expected to be less significant.

Box 1: Land Conversion, Environmental Degradation and Poverty in Kumasi (Ghana)

Due to the general demographic growth[7], lower land and rent prices and to improved, reliable and affordable transport to the urban centre, the areas around the city of Kumasi are becoming the destination of an increasing number of people. Because of such an influx of people from the centre and the periphery, the demand for accommodation and residential developments in many villages around the city is steadily rising; signs of new development can be easily seen around Kumasi and many villages are slowly being absorbed into the urban fabric of the city. Thus, in villages that once were predominantly rural, land is increasingly allocated for residential areas with an associated reduction in the quantity and quality of available farmland. 90% of the villages surveyed in a recent study by the Natural Resources Institute reported a significant reduction in the amount of farmland and an increase in the amount of residential land. This physical transformation has also had an immediate impact on the livelihood strategies of the vast majority of the population in peri-urban areas: households and individuals who until recently could count on access to land as the main resource available for their survival and improvements in welfare have become increasingly vulnerable by the threat of land conversion.

Only a small minority of farmers, usually larger ones, have the resources to compete with developers or speculators in the acquisition of land. Most often land is simply taken from farmers and adjudicated for the construction of new housing (in many cases housing built by and for the better-off wishing to move to the outskirts of the city). As land is being lost, so is the potential of peri-urban agriculture for the production of food for subsistence and of other products, which can be sold on the urban market.

Agriculture plays a major role in the local economy, and in peri-urban villages it represents the most important occupation. Farmers whose land has been sold or whose security of tenure is threatened by the development of new residential areas represents the vast majority of the peri-urban poor. The prospect of land conversion plays against agricultural production in peri-urban areas also in that it creates a disincentive to investment. The reduction in the size of plots associated with an increased population pressure and new developments, implies that the same quantity of crops has now to be produced from a smaller area of land; this can be achieved by an increased use of agrochemicals, by a reduction in fallow periods and by the adoption of more intensive cropping patterns.

The net result of such actions is, in the longer term, a reduction in soil fertility and hence productivity, as well as the creation of potential health hazards associated with the widespread use of fertilisers and pesticides. Also, as the number of residents increases, so does the amount of waste produced (solid, liquid, air, soil and water pollution); as traditional, village-level waste management practices are no longer adequate. Poorer groups have typically little access to water and sanitation infrastructure and they become more exposed to sources of health risk which are not found in rural areas but are rather associated to the expansion of the city and its activities (e.g. non-communicable diseases, heavy metal contamination, etc.).

The vast majority of farmers in peri-urban areas lack access to land as well as the resources to purchase all the production inputs necessary in order to effectively exploit the possibilities offered by the proximity of urban markets. In most cases, the process of land conversion is the cause of a transfer of resources - land itself and financial assets - from the poorer (small farmers) to the richer (larger farmers, developers, speculators). The impact of land use changes is particularly significant with reference to different gender groups. Although they constitute the majority of peri-urban farmers and are central actors in the survival strategies of the poor (food production, household management duties, reproductive duties, etc.) women in fact represent the most vulnerable group. Not only is their capacity for any form of investment limited, but also they are consulted less than men on matters such as land use and plot sales.

In addition to this, as the city approaches peripheral villages, land prices and rents rise. Emerging problems of growing unemployment, homelessness and landlessness give an indication that, despite the potential of peri-urban agriculture as source of livelihoods (foods and market crops), the changes to the environment in peri-urban areas have so far been a cause of increased vulnerability for the poor, rather than an indication of the potentials created by the proximity of the city.

Source: Natural Resources Institute and Kwame Nkrumah University of Science and Technology (1997).

In summary, land use changes may respond to different development trends and shifting environmental practices, and affect a series of environmental problems discussed below.

[7] The latest census (1984) recorded a growth rate of 2.5% in the urban area.

3.1.1 Uncontrolled Urban Expansion

Urban systems *per se* occupy a small percentage of the land surface - just one per cent according to Grubler (1994). Indeed, in countries with high population growth rates, urban development can reduce land pressures in rural areas that are becoming too densely populated and provide economies of scale in the provision of better services and health conditions for more dwellers, as well as offer a greater variety of economic opportunities than rural areas. However, the process of urbanisation is not always accompanied by economic development and access to the advantages offered by cities often remains unevenly distributed in social and physical terms. In addition, uncontrolled urban expansion characterised by low-density development and vacant or derelict land imposes several disadvantages, such as higher infrastructure costs, poorly-planned land use and increasing energy consumption and air pollution due to the greater impact of motorised transport (WRI, 1996). "The result is what might be termed as a '*patchwork'* of different developments, including many high density residential settlements interspersed with vacant land (often held for speculative purposes)" (DAC, 1999: 43). Although this involves the location of informal and formal residential and productive activities, low income groups living in areas subject to recurrent floods or slopes subject to landslides are particularly affected by the negative externalities of marginal environments (see Box 2).

Environmental impacts are not only associated with the scale of land conversion but with the type of land being lost to urban uses. For instance, in the case of São Paulo, Brazil, "the urban core grew from an area of 180 square kilometres in 1930 to more than 900 square kilometres in 1988. The metropolitan region is even larger, covering an astounding 8,000 square kilometres. Prime agricultural land and forest have been converted to urban uses, and development is beginning to move onto steep slopes, which include some of the region's last remaining reserves of natural vegetation. Urban expansion is also threatening the local watershed: an estimated 1 million squatters now live in protected watershed areas, and wetlands located next to rivers and covered by streets and housing" (WRI, 1996: 59).

Box 2: Human Settlements in Risk-prone Areas: the Case of Manizales (Colombia)

The city of Manizales is located in an area characterised by extreme topographical conditions, with an altitude ranging between 800 and 3,400 m above sea level, and frequent seismic events. Because of these conditions, land in what has been identified as the peri-urban interface of the city cannot be cultivated nor easily built upon. The city's physical expansion has reached in particular the northern side of the urban perimeter, on both sides of the Olivares river valley; here new developments are increasingly encroaching on uncultivated areas of high ecological value (e.g. river banks, forest areas) with a direct impact in terms of loss of natural resources (fauna and flora), loss of landscape, effects on soil stability where such developments are located on steep slopes, and on the dynamics of underground waters.

Furthermore, because of the peculiarity of local topographical and geological conditions, in the areas where the city is currently expanding (with both legal and illegal new settlements), land that can be developed safely is extremely scarce. If the municipality's physical expansion plans have so far managed to acquire land for new development from areas with relatively little gradient (although in many instances it has done so at the cost of destruction of natural habitats), the poorer are left with no alternatives than to build in risk-prone areas (steep slopes). Here, the joint effect of poor location, low quality of building materials and seismic activities acts so as to create a significant environmental hazard for this sector of the population. Especially with reference to a resource as scarce as 'safe' land as in the case of Manizales, the lack of means associated with poverty greatly limits the possibility of having access to a 'better alternative'. Besides social and economic factors, any strategy for the enhancement of livelihood strategies should take also this factor into account.

Source: Based on field observation, Manizales-Villamaría, January 1999.

3.1.2 Development of Special Physical Infrastructure

Infrastructural developments such as airports, reservoirs and dams, power stations, drinking water and sewage treatment plants, landfills, clubs and military installations, among others, are characteristically situated within the peri-urban interface. Their location is influenced by factors such as the price and the sizes of land required for their development, the location of natural

resources, and pollution and safety considerations. These infrastructural developments have significant environmental impacts on the environment. For instance, power stations have a potential impact upon the environment in a number of ways. They require huge amounts of water for steam generation and for cooling turbines, and the high temperature and large quantity of waste water discharged to water bodies reduces the ecological quality of water resources through thermal pollution. Power electricity installations operating by fossil-fuels produce large amounts of harmful emissions, such as oxides of sulphur and nitrogen, which lead to the acidification of soils and water bodies and can potentially reduce crop yields. Other emissions such as fly ash impacts air quality, which can cause respiratory diseases.

For operational and safety reasons, the construction and extension of airports is increasingly taking place in the peri-urban interface of many cities in the developing world[8]. The main environmental impacts of airports are the consumption of large areas of land both for airport construction and road development, noise pollution generated by aircraft movement and land and water pollution due to the leakage of aviation fuel.

3.1.3 Loss and Degradation of Agricultural Land and Valuable Ecological Sites

The loss of agricultural land in the PUI is a visible consequence of increasing pressures over land for non-agricultural uses, such as the ones described above (notably, due to expanding urban areas and to demand for building materials and landfills). As pressures are diversified, this results in increasing conflicts over land-use priorities between urban based demand and environmentally valuable functions. In the short term, the loss of agricultural and forest land impacts disproportionately upon the poor, disrupting the life and livelihood of those who depend on agricultural production or, for instance, on the collection of fuel-wood for cooking. In the long term, this process has also multiple effects on the sustainability of urban development, as inputs such as food and water are not available in the immediate hinterland and have to be imported from distant regions. “The loss of agricultural land due to urban expansion is most serious in those developing countries with precarious food-population balance and where expansion consumes the most productive agricultural land” (Nottingham and Liverpool, 1999: 77).

In addition to the above changes, the remaining agricultural land is usually subject to a loss of productive potential, as agro-productive patterns tend to be intensified and rely more on practices such as intensive use of pesticides and intensive irrigation, which in turn result in soil degradation. The decline of land productivity also results from the impact of heavy pollution on soil and water by industries. As land becomes scarcer and livelihoods more diversified, low-income farmers tend to increase their agricultural incomes through the intensification of agricultural activities. This is evident in the shift from subsistence to commercial crops verified for example in several of the peri-urban villages of Hubli-Dharwad.

Environmentally protected areas such as watersheds and wetlands are also impacted by the intensification of agricultural and non-agricultural land uses in the PUI. The loss of singular habitat and biodiversity in these areas is often irreparable.

3.2Use of Renewable Resources

Renewable resources, such as water, food and fuel supplies, are essential for the existence of any system, urban, rural or peri-urban. Environmental problems arise when the renewable resources are exploited beyond their regenerative capacity or, in other words, beyond the “finite limits set by the ecosystem within which they grow” (Hardoy et al., 1992: 182).

3.2.1 Use of Renewable Energy and Deforestation

The loss of forested land or woody biomass is a typical characteristic of the peri-urban interface.

[8] “The growth in air traffic and the demand for new airports is most conspicuous at present in East Asia, particularly China. Twelve new airports are under construction and China is expected to invest 120 billion yuan (roughly £11 billion) between 1995-2000 on the expansion of 402 airports, 137 of which will provide regular scheduled flights” (Nottingham and Liverpool Universities, 1999, p. 80).

The sources of this problem are varied, ranging from the impact of air pollution as in the case of Katowice, Poland, forest clearing by illegal settlers as in the periphery of São Paulo, or displaced farmers in search of arable land for cash crops; or simply due to fuelwood collection, as in the case of Accra, Ghana. Mining, logging and hydropower development also tend to produce increasing deforestation. The loss of forested land has a high impact on the incidence and distribution of vector-borne disease, an issue that will be reviewed in more detail in the following section.

According to the World Resources Institute (1996), "(t)he growth in demand for wood resources around cities has caused deforestation around some urban centres reaching 100 kilometres and more. In India between 1960 and 1986, the closed forest cover around 18 urban centres decreased between one fifth and two thirds. In Africa, urban regions are now experiencing rapid rates of deforestation, as in the peri-urban region of Ouagadougou, Burkina Faso, and the subhumid wooded savannah around Dar es Salaam, Tanzania" (1996:63).

3.2.2 Water Resource Exploitation and Degradation

The peri-urban interface is often the location of water supply facilities, such as reservoirs, or the area where underground water sources are mainly replenished. This is due to the higher infiltration capacity of the system in comparison with urban areas where infiltration is reduced by the large areas of soil covered by hard surfaces such as concrete. In regions depending on underground water resources, a large deficit balance between water extraction and replenishment can lead to water becoming a non-renewable resource. In and around cities, water is commonly in short supply and under increasing competition by different users. Urban growth leads to increasing demand for industrial and domestic use which conflict with agricultural demands, often intensified by shifting irrigation practices. Very often, urban-based demands pre-empt resources which were previously used by peri-urban dwellers or were essential to the health of valuable ecosystems. Water scarcity has impacts on urban, peri-urban and surrounding rural areas, particularly for the poor with little or no access to infrastructure for water provision and water to be used for irrigation. This problem is aggravated by contamination by combined sources (agricultural, domestic and industrial).

World-wide water pollution is caused firstly by agricultural activities and, secondly, by the by-products of human settlements. The lack of pollution-abating infrastructure, involving sewer systems and control over industrial discharges imposes dramatic impacts on watercourses. By-products of human settlements, such as solid wastes, also affect groundwater quality through the percolation of residual liquids. Due to the strong connection between water pollution and inadequate systems of sanitation and wastewater management, sanitation and water supply must be integrated within peri-urban management practices and policies.

Mismanaged water resources are also an important cause of ecological, economic and social problems related with water use. Therefore it is important to assess the efficiency of peri-urban water systems not only in terms of the costs involved, but also in the technologies applied and the strategies for saving water that can be implemented, such as micro-irrigation techniques and reuse of industrial water. Conflicts and competition over water resources are increasingly exacerbated, as those resources become the only source available to several municipalities with overlapping management systems. The lack of intermunicipal co-ordination tends to intensify conflicts among authorities dealing with management of water sources and rivers[9] (Manizales/Villamaría), as well as the absence of bodies with a clear responsibility over the watershed as an 'ecological unit' (Kumasi) (see Boxes 3 and 4 below).

[9] Especially in cases where water bodies constitute the border between two or more municipalities.

Box 3: Water Management Issues in the Greater Kumasi City Region (GKCR) (Ghana)

The urban area of Kumasi - which corresponds to the Kumasi Metropolitan Assembly, one of the five districts of the GKCR (see note 12) - lies on top of a watershed. The pollution generated in the city (petroleum, sawdust, wastes from the brewery, abattoir and tanneries) flows downstream towards its outskirts, affecting agricultural production and health conditions on a regional scale, and contaminating reservoirs and streams which in many cases constitute the only source of water in villages with no access to piped water. Similarly, water pollution is generated also within the peri-urban interface by dumping of human and industrial waste in rivers and by the extensive use of agrochemicals.

Unauthorised activities such as building construction - especially on riverbanks - and the associated extractive activities (sand and stone winning) also contribute to pollution and to flooding due to the erosion of riverbanks. On one hand the individual districts have so far failed to implement existing regulations on industrial pollution[10], waste dumping and protection of waterbeds, and on the other there is a clear institutional vacuum as to what authority should have the responsibility to manage water sources. This does not come under the responsibility of the Ghana Water and Sewage Corporation, which manages reservoirs, ground water supplies and water distribution; and the districts, the regional government (Regional Coordinating Council) and the Environmental Protection Agency have all very limited mandates on this issue.

The problem tends to be left to village-level initiatives, where, however, the conversion from rural to urban land uses is generating increased pressure on the existing natural resources and among them on water sources and rivers. Moreover, local communities and families have no control over what happens upstream and have no responsibilities for water conditions downstream. Hence a situation of fragmentation of efforts and of institutional stalemate results.

Source: Natural Resources Institute (UK) and Kwame Nkrumah University of Science and Technology (Kumasi) (1997).

[10] Corruption and collusion of public officials seems to be a major issue at this regard.

Box 4: Institutional Conflicts over Water Management in the Manizales-Villamaría Conurbation (Colombia)

The municipalities of Manizales and Villamaría form a conurbation of about 440,000 inhabitants and share a very rich and diverse ecosystem as well as a variety of natural resources, in particular water. However, while Manizales has in the last decade put into practice plans to improve urban and environmental quality and nearly achieved population stability, Villamaría lacks the financial resources to do so, especially in view of the fact that in the last 20 years its population has grown by 169% and that most of the new inhabitants are poor groups moving to areas where rents are lower. The outcome of this disparity is evident in the conflicts which have arisen regarding, among other aspects, the management of water resources.

Within the territory of the municipality of Villamaría is located a large part of the Los Nevados national park; despite the potential of this area for tourism, for hydroelectric production and the fact that the park provides water to both municipalities, there are no overall policies for its management and attempts to create joint management initiatives so far have achieved no significant results. Also, the two municipalities have so far failed to implement national programmes and projects aiming at preserving the catchment area in the face of the expansion of the urban area and of the increased number of people moving to the territory of Villamaría.

Water provision is managed by a joint public and private company (Águas de Manizales) in Manizales and by the municipality in Villamaría. Águas de Manizales is also responsible for the treatment of liquid waste and has recently started the construction of a new oxidation plant to treat industrial effluents. The plant will be located on the Manizales bank of the Chinchiná river, which constitutes the border between the two municipalities. The municipality of Villamaría, however, has not been consulted on this initiative and is opposing its construction, fearing that the plant might have an adverse environmental impact on the territory under its jurisdiction. This in turn reflects a wider range of conflicts arising from the lack of joint management of the Chinchiná river basin, shared by the municipalities. The two banks have in fact been put to very different uses. While Manizales launched a programme of construction of water parks for recreational and tourist purposes, Villamaría allowed the location of industries and petrol stations there. There are currently no specific initiatives tackling other problems concerning the Chinchiná river basin, such as the risk of mercury contamination caused by the gold mines in the territory of Villamaría, or the effects on the stability of the river banks caused by extractive activities (e.g. sand and stone winning from the river bed) or by new housing on the river banks.

In the case of water management but also, for instance, of conflicting regulations on industrial pollution or extractive activities, of land use and of waste management, the experience of the Manizales-Villamaría conurbation provides an illustration of how both the need to tackle problems (e.g. pollution, erosion) and to exploit potentials (e.g. hydroelectric production, tourism, valorisation of natural resources, provision of water) in relation to a natural resource shared by two or more administrative units require concerted planning and management efforts rather than unilateral initiatives.

Source: Velásquez, Luz Stella and Pacheco, Margarita, 1999, “Research-Management as an Approach to Solving Environmental Conflicts in Metropolitan Areas: a Case Study of the Manizales-Villamaría Conurbation, Colombia”, in A. Atkinson, J. Dávila, E. Fernandes and M. Mattingly (eds.), *The Challenge of Environmental Management in Urban Areas*, Ashgate, London.

3.3Use of Non-renewable Resources

Most non-renewable resources, such as metals, fossil fuels and other mineral resources, are depleted with stock use and consumption. This poses the need to address their finite nature through the reduction and rationalisation of wasteful consumption and increasing reuse and recycling.

3.3.1 Extraction of Mineral Aggregates and Production of Building Materials

World-wide, the construction industry is responsible for unsustainable practices of exploitation on renewable and non-renewable resources. Construction materials have also indirect environmental impacts due to the intensive use of fuels required in the production of processed materials such as cement and bricks. According to UNCHS (1996b) “the consumption of energy in the manufacture of building materials and components is about 75 per cent of the energy requirement for the production of a building, the remaining 25 per cent being primarily used

during on-site construction activities" (p. 228). In the context of lower-income countries, where construction activities tend to be labour intensive, energy consumption tends to be particularly concentrated in the production and transport of building materials, such as steel, aluminium, cement, brick, glass and lime.

Due to its comparative locational advantages in terms of accessibility, production, and transport cost and time, the PUI is the prime area subjected to extraction of construction materials, which results in increasing natural resource depletion. The great extent of small scale, unregulated and low-technology activities exacerbates the exploitation of aggregate resources. The implications of extractive activities on natural resource management includes:

- "[t]he nature of small operations often means there is no form of Environmental Impact Assessment (EIA) at any stage of the project, as would be the case at any other location. The denser the distribution of these operations in the peri-urban area means the greater are the impacts;
- occupation of fertile agricultural land, soil erosion, pollution of local water resources are common cited problems associated with aggregate resource exploitation" (Nottingham and Liverpool, Universities of, 1999: 79).

However, the production of building materials constitutes a livelihood opportunity for a large number of people in peri-urban areas and the displacement of sources of construction materials further away from urban areas can have a knock-on effect on their costs, at the same time, depriving people of their source of income and demanding more energy for the transportation of building materials. The environmental impacts of the mining activities and the manufacture of building materials can be certainly reduced through appropriate environmental management practices, for instance paying attention to the location of such activities in less vulnerable areas and to the implementation of rehabilitation measures.

3.3.2 Use of Non-renewable Energy

For many urban and peri-urban dwellers in the developing world, a large share of energy needs are still met by biomass fuels, particularly in and around smaller cities in Africa and Asia (WRI, 1996). However, urban sprawl and the increasing ease of access to fossil fuels lead to a disregard for the exploitation of regional renewable resources and alternative energy sources. There is a strong relationship between land use patterns, overall transport demand and motor vehicle use, which results in greater air pollution and traffic congestion. Urban and peri-urban energy-intensive-use has dramatic ecological impacts, not only because of the depletion of non-renewable resources, but also because it is largely associated with the cause of severe environmental global problems such as climate change, acid rain and increased risk of radiation release or accidental oil spills. In addition, the provision of grid line energy beyond a certain radius tends to be expensive and unreliable, and this constrains the provision of electricity to fragmented populations in peri-urban areas.

The type of energy used and the composition of the demand by sector are two basic aspects to be appraised. The analysis of the composition of the demand by sector at global level, shows that the largest consumer is the industrial/commercial sector with 44.5% of total global energy demand, followed by the household and transport sectors with 26% each. However the examination of the composition of energy demand by type of energy, shows different patterns of energy consumption between developed and developing countries[11].

The composition of energy demand by economic and domestic activities is strongly shaped by the economic profile of the city and the living standards of its inhabitants. High levels of energy-consumption are usually linked with high levels of inefficiency and inequity in production and consumption patterns, and aggravated by high levels of resource depletion and pollution

[11] While the household sector is the largest consumer of non-commercial energy (fuelwood and charcoal, crop residues, grasses and dung) struggling, in many cases, to meet minimum energy demands for cooking and heating, the industrial sector in developed countries is the largest consumer of commercial energy (oil, coal, gas and electricity) (IIED/WRI, 1987).

generation at local and global level. However, many urban and peri-urban areas in the developing world are severely constrained by power shortages. For instance, "shortages of electricity have led to several companies with industrial plants in the Hubli-Dharwad city region examining the possibility of having decentralised power generation based on diesel… If the severe power shortages lead to unplanned decentralised power production centres, it may upset the energy balance between urban and peri-urban areas and thus cause more serious problems, such as energy shortages for the rural poor and landless households in peri-urban areas" (Birmingham et al., 1998: 76-77).

In many countries, the transition to oil without a previous structured energy sector led to an unsatisfactory over-reliance on oil and electricity. Modern energy-use is still widely promoted in urban patterns of consumption and production. Although fuelwood is still widely used, particularly by low-income groups, its demand is often not appraised because it is outside the formal linkages with the modern sectors of the economy. This approach favours high productivity areas, polarising industrial growth and urbanisation, promoting a dichotomy in the organisation of energy patterns of production and consumption between rural, urban and peri-urban areas that still remains in force today.

Energy management in the PUI offers several opportunities for the use of renewable resources and a more decentralised approach to energy provision. As suggested in the NRI baseline study for Hubli-Dharwad, "[t]he peri-urban interface contains a number of major production systems, such as poultry units, piggeries and dairies, to support the demands of the urban areas. The close interaction between the urban and peri-urban areas, both in terms of raw materials and finished product transfers, indicates strong links. This leads to the energy needs of the urban area being greatly multiplied to address the energy needs of the peri-urban production systems and the supporting civilisation" (op. cit, p. 77).

3.4Generating Wastes and Pollution

As discussed earlier, usually urban wastes are legally or illegally disposed of in the peri-urban interface, often surpassing the absorptive capacity of these areas and having severe impacts on the health of the ecosystems and the population. The environmental impacts of liquid and solid wastes depend on their source, composition, volume and whether they are informally dumped into rivers or onto vacant land, burnt or disposed of in official dumps or landfills.

Several cases illustrate the conflicts arising in the PUI due to poor or inadequate liquid and solid waste management. This involves both poor management conditions for wastes generated in peri-urban areas and the neglect of the impacts of urban waste management on the wider region. Because of the availability of open space and good access from urban areas, the PUI is often the 'backyard' for waste disposal. The location of dumping sites and sewage treatment plants in the territory of neighbouring municipalities is often a subject of dispute and conflict, as illustrated in the case of Manizales and Villamaría. In the metropolitan area of Bangkok, 90% of the garbage is collected and disposed in official dumps, whilst in the surrounding Changwat, much of the waste is either burnt or dumped into waterways (Setchell, 1995). In Kumasi[12], poor mechanisms for waste collection and disposal and poor implementation of regulations reinforce illegal and unmanaged dumping, particularly in rivers and streams flowing from the city towards its outskirts (see Box 5). In the peri-urban villages, waste management is the responsibility of local communities, and village dumps are mainly managed by women, who suffer disproportionately from the health hazards associated with this activity. In Hubli-Dharwad waste picking is basically reserved to of the lower castes, with women and children representing the majority of waste pickers and hence, again, being particularly affected by unsanitary conditions.

Industrial wastes demand particular attention due to the large amounts of potentially hazardous

[12] The Kumasi Metropolitan Assembly (KMA) is the district corresponding to the urban area. The Greater Kumasi City Region (GKCR) comprises 4 other districts. The GKCR does not constitute a territorial or administrative unit for planning and management. Yet, it describes the geographical extension of the phenomena shaping the PUI of Kumasi.

materials that they often contain. Heavy soil and water pollution by industries tends to impact agricultural land in the PUI, resulting in declining productivity. Air pollutants from industrial urban and peri-urban-based activities also impose severe environmental impacts on a wider region. Pollutants such as sulphur dioxide, oxides of nitrogen, ozone and fluorides can cause considerable damage to forest, soils and agriculture as illustrated in Box 6.

Box 5: Soil Pollution around Kumasi (Ghana)

The main cause of soil pollution in the peri-urban areas of Kumasi is undoubtedly associated with the inadequacy of a waste management system no longer capable of coping with the growing population the Greater Kumasi City Region (GKCR). Furthermore, the administrative fragmentation of the GKCR (one central district corresponding to the urban area and four outlying districts) seem to further compound the problem because of the lack of concerted efforts and co-ordination between districts.

A large proportion of the waste produced within the city affects environmental conditions around the city itself essentially in three different ways: *a*) solid waste is transported from the city's central district to disposal sites located outside the urban area in the neighbouring districts (with an immediate effect on health conditions and agricultural production in the areas surrounding landfills), *b*) liquid and solid waste produced within the city flows towards the outskirts through a dense network of rivers and streams (e.g. petroleum from the large number of car repair workshops located in and around Kumasi, liquid waste from breweries and tanneries, etc.) thus contaminating water and soil, and, *c*) waste is illegally dumped in tips around the city or along river banks. Also, the lack of adequate sanitation infrastructure causes human waste and nightsoil to either contaminate the soil directly or to flow into streams thus contaminating them; as in many instances water from rivers is used also for irrigation purposes, this affects the quality of farming land, the safety of agricultural products and ultimately human health.

On the other hand, the waste generated within the peri-urban interface also affects soil quality. At the village level, concern has been expressed about the joint effect of increasing number of inhabitants and the poor location, rotation and management of pit latrines, which affects not only health conditions but also the availability of safe farming land. Also related to the generation of soil pollution is the location of waste dumps in peri-urban villages (in the proximity of housing or near riverbanks). In the four districts surrounding the urban area waste management is left to the responsibility of the single village, where public authorities seem to play no significant role.

The reduction in plot size associated with the conversion of land from farming to residential uses, has been identified as the main cause for the increased use of fertilisers and pesticides in order to enhance soil productivity; the long term consequences, however, are on the quality and productivity of the soil itself, as well as on the contamination of products from chemical agents.

The social impact of soil contamination is inevitably stronger in areas around the city where land is the most important asset in the local production strategies. The consequences are felt both on soil productivity, and on health conditions in the entire GKCR through direct exposure to contaminating agents and indirect exposure via contaminated food.

Source: Natural Resources Institute and Kwame Nkrumah University of Science and Technology (1997)

In addition to the above, the increasingly common location of industries in the PUI exacerbates the degree of pollution and environmental hazards to the population, due to the fact that solid and liquid waste management tends to be particularly insufficient and unregulated in peri-urban areas. In Kumasi and Manizales, soil and water pollution in peri-urban environments has been recently aggravated by the concentration of industrial polluting activities in the PUI. In the Hubli-Dharwad city-region there are two main industrial areas. One is Bellur, an industrial estate north of Dharwad, and the second is along Gokul Road on the outskirts of Hubli, a zone increasingly engulfed by residential areas. Only 30% of the industrial estate has been actually occupied, but the State government is promoting the location of more industries in the short term, including a thermal power station, a textile plant and an automobile plant. Although the existing plants have treatment facilities, the Karnataka State Pollution Control Board (KSPCB) foresees problems in ensuring that the new plants comply with the existing regulation. The second industrial area is a cluster of small industries (including engineering, chemical and electroplating plants). Most wastewater produced by these industries is inadequately treated, although there are preliminary plans by the State to subsidise the construction of communal treatment facilities, many industries are unwilling to invest in pollution control (Birmingham et al., 1998). Three factors reinforce the problem of industrial pollution in the PUI:

- "there is an increasing tendency towards re-locating heavily polluting industries (toy

factories, plastic factories, oil refineries, paint factories, etc.) from urban areas to peri-urban regions. This is partially due to the toughening of pollution control requirements in urban areas. The peri-urban zone has become the preferable location of such industries due to many factors, including good transportation networks, a well educated workforce in comparison to rural areas, better energy supplies and less rigid pollution control requirements (patterns, rate of processes, etc.);

- in urban areas, it is often a requirement that liquid wastes are treated before being discharged into the environment. Such regulation may not be in place in the peri-urban area and if it is, may not be implemented rigorously. In spite, and probably as a result of this, many of the treatment factories for waste are actually located in the peri-urban region as has already been noted;
- capital resources invested in environmental quality monitoring and management facilities are fewer in the peri-urban area than in the core urban area" (Nottingham and Liverpool, Universities of, 1999: 81).

Box 6: The Impact of Industrial Air Pollution on Peri-urban Agriculture in South-Western China

"The most dramatic examples of damage to crops (and other flora) come in the immediate vicinity of industries with very high sulphur dioxide emissions. Metal smelters without pollution controls and tall smokestacks can cause severe damage to vegetation over areas of hundreds of square kilometres. The emissions from cities do not produce such high concentrations, although a combination of high emissions and a lack of winds to disperse them can mean evidence of damage to vegetation and or falling crop yields. The problem is particularly acute in South-western China – for instance around cities which have high levels of sulphur dioxide emissions such as Guiyang and Chongqing. In the provinces of Guizhou and Sichuan, some 40,000 square kilometres now receives rainfall of a pH less than 4.5[13].

(…) Around Chongqing, large areas of (rice) paddy have turned yellow, following rainfall with a pH of 4.5 while in Chongqing itself, vegetation has been damaged by rain with a pH of 4.1. Reports in 1978 noted heavy industrial air pollution in a district in Lanzhou (a major city and industrial centre) which had destroyed the fruit trees in nearby villages. Furthermore, dates flowered but did not bear fruit, pumpkins failed to mature, and livestock contracted oral cavities which ulcerated, perforated and kept them from eating, causing high death rates"

Source: Hardoy et al., (1992: 119)

As in the case of other environmental impacts, solid and liquid waste disposal in the PUI requires specific management approaches given the combination of different pollutants from multiple sources (domestic, industrial and agricultural). For instance, liquid wastes discharged into terrestrial and freshwater environments in the PUI include, in most of the cases examined, contamination of drinking water sources from untreated domestic and industrial wastewater and from agricultural runoff.

Finally, consideration has to be given to the use and management of waste as a resource. The consideration of flows of wastes and pollution into and across the peri-urban interface highlights the value of adopting a systems perspective in the analysis and management of rural-urban interactions. This has implications not only for the identification of the problems but also for the opportunities arising from those interactions. As highlighted in the NRI baseline study in Hubli-Dharwad, "[t]he use of the peri-urban interface as a framework for researching waste utilisation highlights the scope available for bringing a new perspective to managing waste in [rural], urban and peri-urban areas. There is a shift in emphasis from how to dispose waste to how waste materials can be better utilised and what systems are needed to facilitate increased utilisation. The studies conducted in the Hubli-Dharwad city-region indicate that much waste has been viewed as a resource for many years, but that constraints exist to greater utilisation of waste by near-urban farmers" (Birmingham et al., 1998: 80).

Many traditional practices illustrate this approach, which has also been reinforced in the NRI projects in Hubli-Dharwad and Kumasi. In Hubli-Dharwad, agro-industrial waste from dairies is used to produce dung cakes, which is either converted into agricultural fertiliser or used to

[13] A neutral pH value is 7.0, but for rain a value below 5.6 is considered 'acidic'.

produce biogas. The auctioning of municipal solid waste dates back to 1937, although the quality of composted municipal waste declined with the construction of an underground sewage system and increasing amounts of wastes which do not easily decompose. Both in Kumasi and Hubli-Dharwad there is a large concentration of poultry farms in the PUI, which produce highly organic waste that can be used as manure or for cultivating sugarcane. In the case of Manizales, there are several initiatives for the reuse of organic waste as a fertiliser as well as a base for the production of mushrooms as food supplement. There is plenty of potential for reusing large amounts of waste in agricultural production and fuel generation. However, in absence of proper methodologies there is a risk of creating new health hazards and attracting insect pests, which in turn requires the use of pesticides.

Box 7 illustrates some of the environmental problems and opportunities associated with waste utilisation in the case of Hubli-Dharwad, which include the auctioning of solid waste, the changing composition of solid wastes from organic to non-organic materials, the use of untreated waste water for irrigation in horticulture and the contamination of drinking water by agricultural runoff and industrial liquid wastes.

Box 7: Waste Re-use in Hubli-Dharwad (India)

In the Hubli-Dharwad conurbation there is a long standing tradition of waste re-use and recycling. Solid waste is sold to farmers through auctioning at dumpsites or by tractor-loads for a set price. The waste that is being used is generated both within the urban area and outside. Garbage from the municipal dumpsites is composted and sold as soil fertiliser. However the construction of the underground sewage system has caused a decrease in the availability of nightsoil, which is used mixed with garbage to improve decomposition, with a consequent decrease in the production and sale of compost. An adverse impact on the supply of compost is also related to the changing composition of urban waste (containing increased quantities of plastic, wood, glass and construction waste). Transport costs and the availability of other sources of fertilisers, soil ameliorants and animal feed are also causing a decrease in the sale of solid waste to farmers from villages around the conurbation. In addition to these factors, the lack of resources to maintain dump sites and to hire labour to separate garbage has meant that garbage is no longer efficiently composted into good quality manure.

Most waste generated in peri-urban villages is composted by the household and the small quantities of compost produced are generally enough to be used only on small household vegetable patches.

Agro-industrial waste (dung, poultry manure, sawdust, rice and oil waste) is widely used in agriculture as well as for fuel (dung cakes and sawdust). Untreated waste water is used for irrigation but it might also contribute to health hazards as well as to more weeds and insect pests in the fields, which in turn leads to greater use of pesticides. Nightsoil from pit latrines and septic tank waste is also used as soil fertiliser.

Despite the decline in the market for municipal waste, the increase in waste production in the coming years will on the one hand create problems of disposal, pollution and health hazards within and outside the urban area, while on the other it will also enhance the potential for re-use in agricultural production, energy production (biogas) and for recycling.

Source: Birmingham, Nottingham and Wales at Bangor, Universities of, 1998.

4. IMPACTS UPON THE POOR: SUSTAINABLE LIVELIHOODS AND QUALITY OF LIFE

When considering the impacts of environmental problems upon the poor, Chambers (1997) argues that poverty has many dimensions, not only lack of income. The editorial introduction of the journal "Environment and Urbanization" (1995) observes that "…there is a large literature and experience of poverty reduction in urban areas but most of it is not referred to as such". The experiences are dispersed over many different sectors and tackle many dimensions of poverty, such as "…lack of assets, lack of power, a lack of legal rights…, a lack of access to education, and a very poor quality of housing… and the tremendous health burden this brings with it" (p. 3). Therefore, it is necessary in the first place to define poverty not in terms of income but in terms of the opportunities and constraints that characterise people's livelihoods and quality of life.

The Sustainable Rural Livelihood Framework - elaborated upon a series of contributions at DFID's Natural Resources Advisers' Conference held in July 1998 - provides a useful approach to this task. According to Carney (1998):

> A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from the stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (p. 4).

Based upon this definition and drawing on the work developed by the Institute of Development Studies (Scoones, 1998, cited in Carney, 1998: 6) DFID's Sustainable Rural Livelihood (SRL) Committee proposes a multidimensional framework identifying five different types of assets upon which individuals draw to build their livelihoods, as shown in Box 8 below.

Box 8: Capital Assets

Natural capital: The natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources).

Social capital: The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods.

Human capital: The skills, knowledge, ability to labour and good health important for the ability to pursue different livelihood strategies.

Physical capital: The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue their livelihoods.

Financial capital: The financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options.

Source: Reproduced from Carney, 1998: 7 (adapted from Scoones, 1998).

This perspective overcomes the risk of treating environmental problems in isolation from the much wider development crisis in which they are embedded. Indeed, environmental problems cannot be understood in isolation from the political and economic contexts within which they are created. The very definition of an environmental problem and the priority attached to it by society is a question of tracing it back to its root causes. It is important to stress that "[t]here is no one to one link between people's asset status and the sustainability of their livelihoods. Nor there is an easily definable minimum or 'cut off point' on any single axis below which people can be considered to be 'poor' or 'vulnerable'. Nevertheless, it is intuitive that there is a close correlation between people's overall asset status, the resources upon which people can draw in the face of hardship (inclusive of non-physical assets such as education and access to social networks) and their robustness" (op. cit., p. 7).

This approach can also be applied to the analysis of people's livelihoods and quality of life conditions in the PUI and has the value of providing a holistic view of the different dimensions that shape and reshape people's coping strategies, of which biophysical conditions are important components. In this way, it becomes possible to mainstream environmental

considerations in the assessment of the problems and opportunities faced by the poor in the management of the peri-urban resource base, avoiding at the same time deterministic explanations which portray the poor either as passive victims or as the ones to be blamed for environmental degradation. As highlighted by Douglass (1992),

> [t]he economic struggles by poor households…are not (…) opposed to managing environmental resources in a manner which renews the physical basis for economic survival. (…). Environmental management, no matter how rudimentary or even unsuccessful, is an active concern of poor households (op. cit., p. 23) [14].

Douglass and Zoghlin (1994), in their research in a low-income settlement (Suan Phlu) in Bangkok concluded that:

> …environmental management by poor households cannot be understood in isolation of either the unrelenting demands on them to make a living or the larger encompassing forces that animate the city, national and international economy (p. 194). (…) Households manage, or fail to manage, environmental resources as part of sustaining their daily lives, which involves securing income, investing in the life chances of their children, maintaining social relations and engaging in political action (p. 195).

4.1 Environmental Conditions, Poverty and Access to Capital Assets in the PUI

Rakodi (1998) presents a comprehensive review of concepts about poverty, its possible causes and incidence in urban and rural areas of economically less developed countries, in which she conceptualises poverty as deprivation and vulnerability. Following the livelihood strategies framework described above, she formulates a series of hypotheses on how the poor (mostly rural) are affected by 'urban influence' (changes) in the peri-urban interface. In general, the hypotheses assume a sort of 'urbanisation of injustice': increasing urban influence is thought to increase differentiation between different social groups as the capacity to benefit from changes demands access to a set of resources from the start (or as in the livelihood strategy framework, to different types of capital). The hypotheses formulated by Rakodi in her conclusion are partially reproduced below:

> Comparisons of the incidence of poverty were shown to be problematic, partly because of conceptual and methodological problems involved in using and measuring income or consumption poverty and partly because of problems in defining urban and rural areas. In most countries, the incidence of poverty is higher in rural areas, although the urban-rural gap may be narrowing and the share of the urban poor in total poverty growing. (...) A particular methodological difficulty also relevant to peri-urban areas is the dependence of disaggregated figures on administrative boundaries. Urban boundaries may be drawn tightly or loosely, which may influence findings on the extent of poverty, but however administrative boundaries are drawn, they are unlikely to coincide with the extent of the peri-urban area... (...) However, if this analysis is considered relevant for policy purposes, a possible hypothesis arising from the data currently available would be:
>
> *the incidence of poverty in the PUI is intermediate between that in urban and rural areas for the country concerned, and the incidence is decreasing over time in the part of the peri-urban zone most affected by the urbanisation process*.
>
> *the poor in the PUI will share the general characteristics of poor urban and rural households*: poverty is associated with large household size, high

[14] Songsore & McGranahan (1993) provide a discussion of low-income households practices for coping with poor environmental conditions.

> dependency ratios and low educational levels, and particularly vulnerable groups are poor (e.g. the elderly without support, the disabled, the chronically sick). Female headship will only be disproportionately associated with poverty in those countries where this is the case at national level (pp. 60-61).
>
> (...) Urban households in poverty are mainly those which are excluded from opportunities to earn adequate incomes, and are dependent on poorly paid wage jobs or less profitable informal sector activities, while rural households are predominantly farm households with inadequate access to assets and inputs to either increase agricultural production and incomes or diversify into other IGAs (income generating activities). There is also a spatial dimension of poverty, especially in rural areas where poor regions or communities tend to be located in resource poor or remote regions and areas of population pressure. It would be expected, therefore, that:

Based on the above considerations, Rakodi suggests that the formulation of hypotheses which explain the characteristics and impact of poverty for the people who live in and move into and out of the peri-urban interface, demands the consideration of the complex processes of change underway in the PUI. Especially those related "to farming systems and land use, high levels of activity in the land market and the process of urban development, and opportunities for access to economic activities linked to the urban labour market" (op. cit. p.61). Confronted with urban expansion, farming systems in the peri-urban interface are affected by a number of problems and opportunities, including the opportunities for intensification of fresh produce to meet urban demand; pressures from the subdivision and conversion of farming land for urban development and increasing competition for labour between agricultural and non-agricultural activities. Farming systems are also likely to suffer the adverse impact of dispersed patterns of urban development, reinforcing uncertainty over the future, increased constraints in accessing extension services, and the effects of several environmental problems aggravated with urban expansion such as soil, air and water pollution.

Therefore, the opportunities and problems created by urban systems are likely to produce differential impacts on the household livelihoods dependent on the PUI. Considering how the processes outlined above might affect their access to natural, physical, human and social capital assets, Rakodi proposes the following hypotheses:

> In the early stages of urban influence or the outer parts of the PUI the opportunities for farm enterprises exceed the threats. Those who benefit tend to be the larger farmers and those who are least able to take advantage of the opportunities are smaller farmers who lack capital and surplus land, leading to increased differentiation.
>
> In the later stages of urban influence or the urban fringe areas on the outskirts of the built up area, the threats to farm enterprises outweigh the opportunities, leading to increasing abandonment of farming. Those who benefit from this process are those who can either sell land to speculators or developers or have the capacity to develop it themselves, and those who lose are those who have little or no land, are dependent on wage or casual labour on other farms for all or part of their incomes and are unable to take advantage of alternative economic opportunities in the urban labour market, because households and their members lack labour power, skills, contacts, capital, or freedom of movement.
>
> Those who have insecure rights to land, or who have little to sell, and who are excluded from urban labour market opportunities may be impoverished and, in any case, differentiation is likely to increase. Women are likely to be disproportionately affected.
>
> Farmland may be converted from subsistence food production to either commercial production for the urban market or urban development. If the food producers are unable to access alternative IGAs, households will suffer from increased food insecurity, which will be associated with increased

> malnutrition and poorer health status.
>
> Those seeking new economic opportunities are likely to face barriers to entry erected by those already pursuing particular IGAs. As a result, those who are forced to abandon cultivation and related activities on their own land will become more reliant on casual work or the less lucrative informal sector trading and service occupations, and unemployment rates will increase.
>
> Differentiation in the incidence and severity of poverty will occur between villages within the PUI with relatively poor access to good agricultural land, roads, electricity and marketing channels and those able to intensify agricultural production, diversify economic activities and market their products and labour in the city. (...)
>
> Social capital is weakened as villages experience an influx of new residents, leading to the erosion of traditional authority and community structures and weakening of the social networks which are important in cushioning households against shocks and stresses, thereby perpetuating the poverty of many of the chronically poor and exacerbating the impoverishment of those already disadvantaged in the urban labour market (op. cit. pp. 61-63).

The above hypotheses clearly suggest that the influence of urban systems on peri-urban household livelihoods is not straightforward and might have multiple ramifications increasing or reducing their access to capital assets at different stages of the process. In addition to this, each of the five components considered in the sustainable livelihoods framework deserves specific attention. Whilst emphasis is usually placed on the analysis of natural, physical and human capital assets, social capital plays a key role in reducing vulnerability. As suggested by Rakodi, social capital is under greater threat in areas than rural, reducing households' capability to adjust and react to external shocks.

Different synergies and trade-offs might emerge in each specific context and at different stages. As discussed before, household livelihoods in peri-urban interfaces are subject to rapid changes and increasing pressures that need to be assessed and reassessed in a continuous and systematic way. Rakodi concludes emphasising the need of in-depth understanding of livelihood strategies of low income groups if any strategies addressing their needs are to be formulated:

> To summarise, therefore, research is needed to determine whether the balance between opportunities and stresses in areas of intense urban influence and rapid physical and socio-economic change is positive or negative for different groups of peri-urban residents: indigenous and in-migrant households, poor and non-poor households and communities.
>
> This potential research agenda will need (...) in-depth investigation of livelihoods strategies over time, to ascertain which households are able to gain from the new opportunities for both farm and non-farm economic activities and which are either unable to take advantage of these opportunities because they are already disadvantaged, or are newly marginalised and impoverished. The determinants of the different position and trajectory of different households should be identified, seeking explanations in the asset portfolios available to them and the way in which they manage these assets in a situation of rapid change. Better understanding of livelihoods will, firstly, reveal areas where the most appropriate intervention is to stop activities which hinder households' efforts to develop sustainable livelihoods, but may also demonstrate scope for positive supportive action at the levels of national sectoral policy; local planning, management and service provision; or the development of alternative technologies and techniques for the use of productive resources (op. cit., p. 63) (italics added).

4.2The Need to Disaggregate: Whose Health and Environmental

Problems?

Health impacts are correlated to both the exposure to environmental hazards and risks and infrastructure deficiencies (physical assets). Uncollected garbage, inadequate water supply and sanitation, overcrowded living conditions and air pollution are common problems affecting peri-urban communities. The poorest in the PUI face greater exposure to biological and physical threats and also more restrictions on access to protective services and infrastructures. The breakdown of traditional environmental management practices appears to be largely associated with increasing exposure to health hazards and environmental degradation (e.g. increased use of non-organic fertilisers).

The relationship between low income groups, environmental and health problems is embedded in their conditions and places of living. Lack of access to environmental services, poor housing quality and the occupation of lower quality sites (and associated risks and environmental transformations) are conditions under which a large proportion of the population of 'Third World' cities lives. As already noted "[I]t is the poorer groups who bear the most of ill-health and other costs of environmental problems" (Hardoy et al, 1992: 100). For example, in relation to water-related diseases, "the health risks…are heavily concentrated in the developing world and, within the developing world, among the poorer urban and rural households of the poorer countries" (WHO, 1992: 116).

Birley and Lock (1998) provide a general framework for the linkages of health and the use of natural resources[15] in the PUI, as a generalisation, they assert that:

> The peri-urban environment receives waste from organised collections in the city, in the form of landfill sites, refuse mountains and polluted rivers. Both indoor air pollution and outdoor air pollution is present as a consequence of road transport, energy production, industrial activity and cooking. People often change their work patterns as they migrate to the city: paid work more frequently takes place away from home, for both adults and children; the cost of commuting limits the separation of living and working zones; less time is available for caring and nurturing. Food consumption patterns change: babies are weaned earlier; food is cooked less frequently, stored longer or purchased from street vendors (op. cit., p. 92).

As a way to build a hypothesis about health issues affecting the poor in the peri-urban interface (since little specific information is available), the authors explore the transition of types of health risks from urban to rural, what they call **a rural-urban health transition hypothesis.** In their view, "the total risk may sometimes be highest in the peri-urban area: poor peri-urban communities may then live in the *worst of both worlds"* (op. cit., p. 94). This worst situation would be the result of incidence of both 'modern' (related to urban societies, mostly non-communicable or associated with injury, over-nutrition or psycho-social disorders) and 'traditional' (related to rural, mostly communicable, or associated with under-nutrition) health hazards. The discussion on the possible health problems affecting the poor in peri-urban areas is summarised in Table 1.

[15] See Figure 1, op. cit., p. 93.

Table 1: Health Problems in the Peri-urban Interface

Type of problem	Description and source	Factors, paths of contamination, affected groups
Malaria and Agriculture	All environmental modification of tropical and sub-tropical environments leaving pools of standing water is likely to affect mosquito reproduction. Promotion of urban agriculture may substantially increase the malaria risk by introducing new mosquito breeding sites	The frequency of illness and the abundance of malaria mosquitoes changes from one district of a city to another as a result of mobility of its population, the abundance of breeding sites for the mosquito and the quality of housing and services
Heavy metal poisoning	Contamination of plants with heavy metals may occur through the air (from road traffic) as well as from the soil and irrigation waters	Contamination of crops with heavy metals entering the human food chain could lead to chronic poisoning of consumers. Other linkages environment-consumers are edible fish from contaminated rivers and streams
Industrial and domestic wastewater re-use	Use of wastewater in peri-urban agriculture (irrigation, biogas production, fertiliser for crops and fishponds) is extensive and unregulated. Wastewater used for irrigation may include industrial effluents, containing heavy metals, or domestic waste containing pathogens	Possibility of contamination of both workforce and produce (thus, consumer), depending on crop type, method of irrigation and working practices. Possible contamination by persistent virus, which can also accumulate in the sludge of waste treatment plants
Solid waste re-use as soil fertiliser	Where markets for solid waste exist, they support many destitute people who may live or work on refuse dumps that are often located in peri-urban areas	Composting organic waste for use as soil improver may help decomposition by the destruction of pathogens by heat. However, this is only successful under certain conditions and there is a risk of introducing unacceptable concentrations of heavy metals into the food chain. Those who live or work are subject to health hazards that include, e.g., raised levels of infant mortality, body injuries, intestinal and respiratory infections, eye and skin infections, and poisoning
Agro-chemical poisoning	Chemical compounds, biological and physical agents are used as insecticides, fungicides, herbicides, rodenticides, fertilisers and anti-microbials. Exposure pathways can be both occupational and non-occupational	Unintentional acute and chronic pesticide poisoning is an occupational hazard of agricultural workers. The level of risk of exposure to chemicals is usually higher in intensive farming and horticulture than in traditional farming. Chronic illness has also been associated with agro-chemicals in the food chain, including in red meat, poultry, vegetables and eggs. Wild food consumed by the poor may be collected among sprayed crops. Pesticides and fertilisers can contaminate drinking water (surface and groundwater).

Biomass fuels: respiratory diseases, injury and malnutrition	Identified hazards include: indoor air pollution from biomass and fossil fuel burning; exposure to high levels of outdoor air pollution; and serious injuries associated with extraction, storage and power generation	The poor may have reduced access to less polluting technologies, pay more for fuel than the more wealthy, and live in areas more affected by industrial or traffic pollution. Household cooking on an open fire has been described as the largest single occupational health problem in the world for women. Collecting fuelwood and water, and of other domestic chores may represent a large proportion of women's daily energy expenditure. Workers in, e.g. brick-making, may be also subject to health hazards form biomass fuel burning
Malnutrition, food security and food safety	Rates of malnutrition are much higher in poorer areas and the differences between poor and wealthy areas are greater than urban-rural differences.	Diarrhoea is still the major cause of morbidity and mortality in children and food contamination is an important cause. Undernourished children are more susceptible to communicable disease and are more likely to die. Women and children are especially vulnerable because of differential entitlements that occur within the household Childhood malnutrition is dependent on maternal care. Food preparation and storage in poor domestic environments provide many opportunities for contamination and working burden on women may influence this.
Psycho-social disorders	Mental disorders grow as a component of modern diseases in health transition. Risk factors include poor physical environment, switch from subsistence to cash-cropping; insecure tenure; rural-urban migration; underemployment; etc.	Rates are about twice in women because they are often victims of violent or alcoholic family members. An important set of risk factors includes life stresses combined with the corresponding lack of resources to resolve them.

Source: The text (although slightly reorganised) is reproduced from Birley and Lock (1998) pp. 94 -106.

However, this 'transition hypothesis' is questionable in so far as urban, peri-urban and rural areas should be expected to be heterogeneous. Conceptualising 'peri-urban' as a transition between two (implicitly) homogeneous situations may be misleading. As pointed by Rakodi (1998), "[i]nformation on the health status of rich and poor urban and rural dwellers is limited, and the hypothesis that peri-urban residents are subject to a particularly high level of risk, giving rise to high levels of mortality and morbidity, has not been tested" (p. 48).

Impressive as statistics on the health burden of low-income groups may be[16], until recently (late 1970s, early 1980s) the research on urban health problems has focused on the city as a whole (in an aggregated form). In this way, urbanisation has been perceived as a positive process in terms of health (Stephens, 1996a; Tunner and Harpham, 1995; Todd, 1996). Table 2 below illustrates typical health differentials and, therefore, the need of disaggregation for the proper understanding of health and environmental problems.

Table 2: Intra-urban Differentials: Infant Mortality Rate in Bangladesh in 1991

[16] See Hardoy et al, 1992.

	National	Rural	Urban	Urban Slums
Total	90	93	68	134
Male	98	97	70	123
Female	91	89	65	146

Source: Reproduced from Tunner and Harpham (1995: 36).

Most studies on the inequality of ill health are descriptive and focused on the relationship between people's ill health and inequalities in the physical and sanitary environment at the neighbourhood or household level (Stephens, 1996a; Todd, 1996). However, the relationship between health problems and risk factors in the physical environment at the household and neighbourhood level is mediated by people's agency in managing their environment - which in turn is affected by socio-economic factors. In other words, 'social capital' and the capacity to organise for collective action are important elements in mediating the exposure to risks and health outcomes[17].

Pelling (1997) presents evidence that housing ownership and the level of community organisation can influence vulnerability to floods and to their associated health risks. At the household level, Joekes et al. (1994), studying a low-income community in Mexico City and the role of women in managing the household environment, show that gender relations put women on the front line of exposure to the pervasive sewage contaminated water. Overall, there is indication that the transformations in the social, economic and natural environment related to the peri-urban interface have a strong gender dimension. Box 9 looks at the relationship between gender, poverty and health in the city region of Hubli-Dharwad, showing that the changes in the roles performed by women and their increasingly vulnerable social status contribute to reinforcing the risk of exposure to health hazards related to pollution, contamination and injury.

As demonstrated by Stephens et al. (1997), there are great social and spatial inequalities that operate at the urban (and peri-urban) level. Most importantly, the authors suggest that these inequalities go beyond the effects of local environmental conditions, or the sanitary environment at the household or neighbourhood levels. This situation is defined as a 'double trap of social-environmental risk': "[i]n reality, there is increasing evidence that the double burden [communicable and non-communicable diseases] is not shared between groups within cities and that the urban poor die disproportionately of both infectious and chronic, degenerative diseases" (Stephens, 1996a: 127).

It must be noted here that this idea is very similar to the 'worst of both worlds' hypothesis of Birley and Lock (op. cit.) based on urban-rural extrapolations. The poor in the urban areas are already subjected to traditional and modern health hazards. Stephens (1996b) points out the fact that traditional approaches of provision of basic needs and services to the poor - important as they are - may be insufficient to address problems that are the result of broader social inequalities in cities. Health inequalities (at the household, neighbourhood and city level) cannot be understood only as inequalities in the physical environment: they are a product of social inequalities (Atkinson et al, 1996; Todd, 1996)[18]. It is difficult to hypothesise about health in the peri-urban interface, as inequalities among different social groups living in the peri-urban interface might be greater than rural-urban (as discussed in the case of intra-urban inequalities).

[17] See Songsore & McGranahan (1993).

[18] However, as remarked by Stephens (1996 a, b), studies of urban environmental health have been generally unable to address this issue.

Box 9: Gender, Poverty and Health in Peri-urban Hubli-Dharwad (India)

Because of the concurrent effect of different factors, during the last 15 years non-farm employment opportunities have increased substantially around the conurbation of Hubli-Dharwad, particularly for men. Although the overall participation of women in the labour force has also increased, it has concentrated in agricultural production, which however represents the sector with the lowest salaries; also, as women are less paid then men, the fact itself that their participation in agricultural jobs has increased has been identified as one major factor in keeping salaries low. Poverty in the areas around the city tends therefore to have a strong gender dimension.

Along with children, the proportion of women tends to be greater in the selection, recycling and composting of municipal solid waste in dumpsites; however, there is no clear data and information as to the economic contribution of such activities in individual and household livelihood strategies. Women also represent the majority of waste pickers, collecting recyclable materials (e.g., paper, glass, wood) from bins and dumps and reselling it to itinerant buyers.

At the community level, women are typically engaged in the management of dumpsites in peri-urban and rural villages. Within the household division of labour, women perform productive and reproductive roles which, among other activities, involve the composting of organic waste and its re-use in horticulture as well as a wide range of duties related to the collection, production and use of energy (e.g. firewood, dung, water). As firewood becomes increasingly scarce around the city, its collection requires walking longer distances, which in turn has an impact on the quantity of time available to perform other roles and on health conditions (head and back injuries caused by transportation of fuelwood). Peri-urban areas are characterised by poor infrastructure which, in case of water provision, makes women more exposed to water-borne diseases and pathogens contained in contaminated water. Evidence however shows that in the case of Hubli-Dharwad women are not involved in the use of wastewater on land as soil improver. A further health hazard comes from the frequent and intense exposition to stoves for cooking and hence to the potential for respiratory disorders related to smoke inhalation and to fire incidents.

Sources: Birmingham, Nottingham and Wales at Bangor, Universities of (1998).

As discussed above in relation to health, there is a diverse range of different urban environmental problems, with their origins and impacts unevenly distributed spatially and among different social groups within the city. Urban environmental problems need to be disaggregated for a proper understanding (Satterthwaite, 1997). As a broad generalisation, the impacts of urban affluence usually have a much broader spatial dimension and are associated with over-consumption and high generation of wastes (e.g., city-wide air pollution, use of natural resources on a wide geographical scale, etc.). The environmental problems linked to low income groups are mostly confined to the household and neighbourhood levels (McGranahan et al., 1996).

Table 3 presents, in a very simplified manner, general tendencies in the correlation between environmental problems, income levels and spatial distribution of impacts, showing the diversity of overlapping situations within the city and its region. It suggests that there is a transition where household and neighbourhood problems are the first to be solved as income increases (probably transferring environmental costs to other areas and social groups).

Table 3: Environmental Problems, Level of Income and Spatial Distribution of Impacts

Level of income	Spatial distribution of impacts	Related environmental problems
Low-income	household and neighbourhood	Sanitation, access to drinking water, squatter settlement and health-associated brown agenda issues such as respiratory, diarrhoeal and contagious diseases; environmental disasters and life threatening conditions.
Medium-income	city-wide and regional	Industrial pollution, water and air pollution (e.g. SO_2), contamination of water resources through municipal discharges, etc.
High-income	regional and global	Air pollution associated with motor vehicle emissions and regional climatic conditions (CO_2), environmental contamination and food chain contamination with persistent organic compounds, intensive use of natural resources, etc.

Source: Based on McGranahan et al. (1996).

4.3The Political Economy of Access to Land

If the PUI is related to intensity of conflict and change, the review produced by the Universities of Nottingham and Liverpool (1999) indicates that land and land disputes may be the most visible facet of these processes: "...whenever the peri-urban area is located at any given point in time, [it] is usually the principal zone of conflict in terms of tenure" (op. cit., p. 29). Douglass (1992) observes that "[t]he coincidence of extreme poverty and extreme environmental stress is the outcome of political, social and economic relationships that have no single point of entry or resolution" (p. 16). Access to land is a key issue identified by Douglass, as in Box 9 below.

Box 9: Lack of Access to Urban Land and Related Issues in the Relationship Between Poverty and the Environment

1? The poor occupy low commercial value land, normally environmentally unsuitable – steep slopes, prone to flooding, near factories and refuse dumps;

2? the insecurity of tenure is associated with low investment for improvements by the poor;

3? illegality of occupation results in government denial of infrastructure and public services needed to improve environmental conditions;

4? illegality is also closely related to governmental unwillingness to recognise community organisations that emerge and seek assistance in the provision of infrastructure and basic services.

Source: Douglass (1992: 16-17).

Silva (1998) argues that struggles for appropriation and use of land are important entry points for the understanding of the relationship between low income groups, environmental change and health[19]:

> As a broad generalisation, the combined operation of political decisions

[19] Abaleron argues that "[h]ousing, understood … as the housing process, provides an entry point to the problem of marginality…. first, because housing is the most visible aspect of marginality, and second, because the type and quality of housing are important determinants of quality of life" (1995: 102). Williams also argues that "...the question of urban land and its management" is fundamental for its influence on peri-urban environmental problems (1994: 247).

> related to planning and infrastructure and the logic of formal 'land and housing markets' have confined affordability by low income groups to unserviced land and land legally defined as non-developable (which includes areas protected for environmental reasons). At the same time, the increasing commercialisation of informal land delivery systems have furthered the disadvantaged position of the lowest income groups in relation to access to services and proper sites for living. As a common outcome of these processes the places of living of low-income groups - and particularly the lowest income groups within them - tend to be associated with 'marginal urban environments'. Places that, for their environmental conditions or risks (but also for other factors such as difficult accessibility and high costs of transportation) posses low commercial value or attract little competition from other social groups as places for living (p. 32).

Three important issues (taken from Silva, 1998) have to be remarked here (obvious as they may be) as hypothesis linking poverty and the peri-urban interface as a living and working environment:

a? Affordability, Infrastructure, Planning Regulations

Traditional or customary land delivery systems have been increasingly transformed into commercial forms, particularly in the context of rapid urban growth (Baken and Van der Linden, 1990; Durand-Lasserve, 1998): "… whether backed by legal or illegal forces, claims to land have become much stronger and are defended much more vigorously than they were before" (Baroos and Van der Linden, op. cit., p. 8). Within this context, Baroos (1990) identifies, *inter alia,* two sources of affordability of land to low income groups:

- firstly, the occupation of unserviced settlements or settlements provided only with rudimentary infrastructure. As the level of development of settlements influences prices, lack of development itself is a very important point related to access to land by low-income groups. Occupying unserviced land helps to internalise the gradual price increases resulting from each development step (from occupation, building, servicing, etc.), and from "…the gradual absorption of their [low income groups] settlements into the urban structure" (op. cit., p. 57);
- secondly, the use of land that is not allocated to urban use by formal planning, including that legally protected for environmental reasons or as valuable agricultural land. Planned development "…adds a premium to the favoured part of the city…" (op. cit., p. 65) [20] and lowers the prices of "… areas where agricultural use is conserved, recreational development is proposed or future development is prohibited (e.g., flood zones, aquifers, hazardous slopes, forest resources, etc.)" (op. cit., p. 59-60). These two sources of affordability are directly linked to environmental problems faced by low-income groups;

b? Competition within Informal Land Delivery Systems

Despite many plans to incorporate low income groups in formal (public and private) land delivery, illegal forms of land delivery have formed the main channel of access to land for low income groups (Baken and Van der Linden, 1992). The upper-income focus of capitalist formal land and housing markets has also turned informal building plots increasingly attractive to middle income groups in 'Third World' cities (Durand-Lasserve, 1990). Baroos and Van der Linden (op. cit.) draw attention to the fact that illegal, but officially tolerated, forms of commercial subdivision of land are becoming increasingly important[21]. Informal private commercialisation has been identified as the main land delivery system even in cases where land is supposed to

[20] "…a premium which is largely appropriated (and not infrequently induced by) landowners/developers themselves" (ibid.). This dynamic is expected to be particularly intense in situations of rapid urban growth and scarcity of available land (which can be induced by landowners).

[21] They refer to "Substandard Commercial Residential Subdivision", typically involving: planned layouts, low service levels, suburban locations, high-tenure security, non-conformity with urban development plans, and 'self-help' housing (op. cit., p. 5).

be allocated by the state, as in Dar es Salaam (Kironde, 1995); or where the majority of urban land is owned by the government, as in Karachi (Nientied and Van der Linden, 1990).

The increasing commercialisation of and competition within informal land delivery systems are illustrated by Thirkell (1996), in a study of Cebu City (a secondary city in the Philippines). The participation of middle income groups in informal land markets has "…placed pressure on supply, resulting in high land prices, effectively reducing accessibility by low-income families" (p. 76). As Thirkell observes:

> The wider implications…are that the informal market is divided, with low income families accessing fewer residential sites which, in turn, creates enormous pressure on poorer, less desirable sites in foreshore areas. (…) *However, the most alarming result is the heightening of conditions of poverty in the poorer quality sites of the city as the poor can no longer afford to compete within the wider informal land market* (op. cit., p. 90). In other words, the lowest income groups are being confined to *foreshore and canal and pavement areas which do not attract middle-income buyers* (op. cit., p. 81) (italics added);

c? Marginal Urban Environments and Places of Low Political Resistance

As a common outcome of the processes briefly discussed above, the places of living of low income groups — and particularly the lowest income groups within them - tend to be associated with 'marginal urban environments' (Main and Williams, 1994):

> Marginal urban environments are sited in and/or around negative externalities. These negative externalities are natural or man-made features of urban environments that make nearby residence unattractive because they entail actual or potential ongoing problems for local residents and/or threats of disaster (…) [T]he areas of the city that are affected by most negative externalities can be identified fairly closely (p. 153).

From the general disadvantaged position of low income groups within the struggle for land appropriation and use *vis à vis* other social groups, their relationship with the environment appears to be a sign of their low political status and lack of access to political decision-making (Silva, 1998). Harvey (1995) calls attention to another aspect of the relationship between low-income groups and the environment: low-income neighbourhoods are favourable sites for toxic or noxious activities. Much of peri-urban environmental concerns related to low income groups are associated with land (degradation of wetlands, coastal zones, occupation of other environmentally sensitive and hazard-prone areas)[22]. Therefore, not only places of living tend to be marginal urban environments, but also - from an economic and political logic - toxic and noxious activities tend to be localised around low income settlements where, most likely, the economic costs and possible compensations are lower, political resistance weaker and political support for job creation is more likely [23] (Harvey, 1995).

Finally, consideration has to be given to the administrative fragmentation of land management and the role of traditional cultural systems in the process of land conversion. Changes in the peri-urban interface are also affecting the way in which these traditional systems have operated for a long time as a social contract regulating the relationship between community and environment, as illustrated in the case of Kumasi (See Box 10 below).

[22] See Bernstein, 1994; World Bank, 1991, p. 74; UNCHS, 1996a, p. 47.

[23] As Harvey observes, "…it is not unknown for reasonably democratic debate to generate a political consensus in favour of accepting toxic waste facilities on the grounds that this generates otherwise unavailable income or employment" (1995: 68).

Box 10: The Role of Traditional Cultural Values in the Process of Land Conversion: Implications for Poverty and the Environment (Kumasi, Ghana)

Most of the land in peri-urban areas of Kumasi is not property of the state or of individuals but is under the control of the traditional Ashanti authority, the Golden Stool, whose territorial domain has no relationship whatsoever with the jurisdiction of any formal administrative unit in the Greater Kumasi City Region. Traditionally, land is considered sacred as a source of life, hence it cannot be owned by individuals. At the village level, the 'chiefs' act as intermediaries between this key natural resource and the community[24] on the basis of a relationship of trust. As the chiefs have control over land, they represent the main driving force in the process of land conversion in the PUI. In a growing number of instances, disregarding traditional values which appoint them as custodians of the sacred land in the interest of the community, whose livelihoods continue to depend on the relationship with land, village chiefs are increasingly adopting commercial criteria in disposing of communal land[25].

The funds received by the chiefs from land sales are not always redistributed or reinvested in the community in the construction of communal facilities (a school, paving of a road, water pipes, a church and so forth), but rather satisfy the chiefs' personal interests. Also, land transactions often take place with little or no consultation with the villagers[26].

Traditionally, the role of the chiefs has been that of preserving the relationship between the communities and the environment, a relationship which, as already mentioned, primarily involves access to land. It does however also include the way other resources (vegetation) and specific sites (rivers and their banks) are used and worked on. Traditional cultural values translate into action the knowledge local communities have of the environment to which they have access and with the resources of which they are able to make a living. On this basis, specific activities (hunting, building, and cultivation) are prohibited in those sacred sites either throughout the year or during specific periods. Over the centuries this has contributed to the conservation of local natural resources.

As chiefs in peri-urban villages are increasingly adopting a commercially-oriented behaviour to exploit the opportunity offered by the city's expansion and the associated demand for land, this not only undermines the traditions on which social cohesion in peri-urban villages has been historically based, but also entails consequences such as: unauthorised new developments, many of which in traditionally sacred areas, loss of endemic vegetation and fauna along river banks and in sacred groves, excessive run-off from river banks and ultimately a risk of flooding of the surrounding areas, soil erosion, loss of land by farmers, as well as an increased number of disputes between chiefs and members of the community and chiefs and land purchaser, with an associated upsurge in violence.

Because of the administrative fragmentation of these areas, of the lack of resources and because of the collusion of public officials, public institutions play a passive role in implementing laws and regulations, and initiatives are largely left to the single villages.

Source: Natural Resources Institute and Kwame Nkrumah University of Science and Technology (1997).

5. CONCLUDING REMARKS

This section draws a series of conclusions from the above analysis, highlighting the implications for strategic EPM of the peri-urban interface:

- the peri-urban interface can be defined as a particular type of metabolic support system, in

[24] The chiefs have the 'allodial' (allocation) right on land.

[25] A major tendency has been reported in peri-urban village of shifting from stool/communal property to individual property of land.

[26] Only in a marginal number of villages Planning Committees have been constituted providing a representation of the community's interests in planning and management matters in the village.

which the value of the configuration is much higher than the sum of the value of its component parts. The assumption is that these configurations are characterised by particular possibilities and conflicts due to the physical proximity of different land uses and related social, economic and physical processes;

- environmental degradation in the PUI cannot be addressed in isolation from the processes taking place in a wider region. On the one hand, environmental problems affecting the quality of life of the poorest demand urgent attention, on the other, these issues cannot be separated from the long term problems affecting the sustainability of the natural resource base. This ultimately demands broadening the focus of EPM beyond localised environmental problems to a consideration of the sustainability of the urban bioregion;
- geographical and administrative boundaries prevent a strategic approach to the environmental planning and management of the PUI that is holistic enough to include concerns at the city-region level and take into consideration at the same time the specific problems affecting peri-urban dwellers. Neither the brown agenda priorities of peri-urban communities, nor the longer term issues affecting the sustainability of the city region are likely to be addressed by municipal authorities, unless specific fora are set up for this purpose. Urban EPM processes tend to neglect both issues, although increasing attention is starting to be paid to the management of the natural resource base in the peri-urban interface, this rarely involves peri-urban communities as key stakeholders in the process;
- although there is a strong correlation between the green and brown agendas, environmental problems in the PUI cannot be addressed from the mere perspective of the sustainability of urban development, nor from sectoral interventions in some peri-urban villages. More attention needs to be paid to the synergies and trade-offs of EPM responses. For instance, reusing urban waste as compost is often seen as a potential strategy to reduce the amount of wastes that are otherwise simply disposed of or dumped and to increase the productivity of the soil for farming activities in the PUI, thus enhancing livelihood strategies. However, the synergy between these two objectives has to be analysed in the light of other aspects such as access to land for farming purposes, and market conditions for selling the compost;
- the peri-urban interface is not only subject to the influence of nearby urban systems but, as discussed by Douglass (1998), influenced (or created and sustained) by different types of urban-rural linkages (which may be represented by different types of flows operating at different scales): immediate and more distant interactions. Urban-rural interactions are diverse and operate at different scales, affecting each specific PUI in diverse forms. They are diverse both in relation to their types (quality and quantity) and scale (local, regional, national, international). Urban-urban and rural-rural, or international-local interactions may also form the basis of the organisation of 'peri-urban interfaces';
- the assumption that rural migration to urban and peri-urban systems relieves pressures from rural areas and enhances the quality of life and opportunities of the poorest requires further analysis. In particular, greater attention should be paid to the actors involved in the change in land use taking place in the PUI, and who benefits and suffers from them. As pointed out in the literature review on peri-urban natural resource conceptualisation and management approaches, commissioned by the Natural Resource Programme,

  > [i]t is still not yet clear if the pressures for land use changes within peri-urban areas stems from in-migration from more distant areas. (…) Changes may also result from some or all indigenous families choosing to engage in non-farm activities, perhaps by commuting to work in the nearby city. The pressures for land use changes, however, may stem from out-migration of city residents into the peri-urban areas (…). Other, more speculative pressures, however, may also be involved in these land transactions. (…) Some agricultural family members may become landless labourers, rent or buy land elsewhere to continue farming, adjust their farming practices, or enter the urban non-farm labour market. *The barriers to this adjustment process need to be understood if interventions are to be made successfully* (Nottingham and Liverpool Universities, 1999: 181) (italics added).

- environmental problems and opportunities need to be analysed in the context of their political

underpinnings, conditions and ramifications that are derived from socio-economic inequalities and political processes. The differential social and economic impacts of environmental change not only have implications in terms of winners and losers, but also political implications altering the power of actors in relation to other actors. For example reducing the ability of some actors to control or resist other actors, and upon the institutionalisation of responses to the environmental problematic. "It may be possible that peri-urban areas are actually drained of resources and public sector investments through not receiving their 'fair share' of public sector attention. It appears likely that the provision of environmental and other services or facilities do not appear to be geared towards assisting changes in the peri-urban areas, or preventing environmental health or other problems in advance" (Nottingham and Liverpool, 1999: 182);

- if on one hand the rural poor are hypothesised to lose, the urban poor will probably have access to 'peri-urban interfaces' as places for living as 'marginal environments' (pollution, lack of accessibility, etc.) which in turn may turn out to be favourable sites for locating industries, dumpsites, etc. This process seems to be dependant on the political clout and access to political decision making by low income groups. This is the key issue in a Strategic EPM that benefits the poor. As Rakodi (1998) suggests:

  > …a fragmented pattern of development of illegal subdivision for both upper and lower income groups occur. The provision of water, energy, and other infrastructure to such areas *depends on the political system and the political clout of their residents*, their location in relation to city-wide systems and the capacity of the latter to extend provision (which may be subject to physical, financial and organisational constraints), as well as the income levels of residents and investors (op. cit., p. 46) (italics added).

- although the PUI has been conventionally related with poverty, it is clear (as Rakodi states) that this is not the case, from both urban and rural perspectives. Intensive agriculture and adequate housing can be a privilege of higher income groups. However, it is also clear that the poorest are also present in the PUI (as they are in particular spaces in the city). The development of peri-urban interfaces for higher income housing, for industrial purposes, for intensive agriculture or for transport infrastructure (airports, roads, etc.) creates opportunities for low income groups, however conflicts in the access to different types of capital are also likely to be intensified, with the poorest often being at the losing end;

- 'peri-urban interfaces' must be disaggregated and livelihood strategies must be researched if a strategic EPM that benefits the poor is to result. The analysis suggests the existence of very heterogeneous socio-economic groups in the PUI, with the poor becoming increasingly poor. On the one hand, low-income groups dependent on natural resource activities may lose access to livelihood resources and might miss out on the opportunities related to 'peri-urban' changes. On the other hand, those engaged in urban-based activities may be subjected to two inter-related processes. First, the development of urban influence (particularly land value changes and infrastructure) may confine their places of living to new marginal environments (depending on their political clout and opportunities for living in the city). Second, as in Harvey (1995), and assuming that low-income areas are both of low political resistance and in need of job opportunities, they will be preferred as sites for noxious activities.

>From the previous discussion it may be clear that a strategy to benefit a particular social group is essentially a political enterprise. It is therefore necessary to identify key elements that, in principle, should be investigated and addressed in EPM for the peri-urban interface. However, the most important aspect of a strategic EPM that benefits the poor is obviously related to the possibility of participation of the poor themselves in the definition of priorities and in political decision-making, which is also, as discussed above, a central element in the relationship between sustainability, poverty, environment and health.

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